Chapter 296-62 WAC General Occupational Health Standards
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PART A
GENERAL

WAC

WAC 296-62-005 Occupational health and environmental control--Foreword.

(1) **Foreword.**

(a) Modern industry is changing at an ever-increasing pace. New inventions, discoveries and developments cause changes in every facet of the industrial process. In keeping with this changing technology is the necessity to provide an adequate guide for the protection of working men and women. This chapter is for the guidance of both labor and management and to call particular attention to the way in which modernization and updating of the standards can be accomplished.

(b) This chapter is intended to cover as fully as is practical the environment in which work is performed. In addition to the suggestions made herein, the services of modern occupational medicine must also be considered. Occupational medicine with its specialized techniques for examination, diagnosis, and treatment adds another protection for the worker as he encounters newly-developed materials and methods.

(c) With the full realization that close cooperation between government and industry, labor and management, and all the health sciences, is essential, this chapter is promulgated for the health of all the workmen coming under the jurisdiction of the department of labor and industries.

(d) This chapter is promulgated in accordance with the applicable requirements as outlined in the Washington State Administrative Procedure Act (chapter 34.04 RCW) and other applicable statutes.

[Order 73-3, 296-62-005, filed 5/7/73; Order 70-8, § 296-62-005, filed 7/31/70, effective 9/1/70.]

WAC 296-62-010 Purpose and scope. The rules in this chapter are designed to protect the health of employees and help to create a healthy workplace by establishing requirements to control health hazards. Requirements for chemical hazard communication programs, workplace lighting levels and exposure records are in chapter 296-800 WAC, the safety and health core rules.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-010, filed 05/09/01, effective 09/09/01. Order 73-3, § 296-62-010, filed 5/7/73; Order 70-8, § 296-62-010, filed 7/31/70, effective 9/1/70; Section I, effective 8/1/63.]

WAC 296-62-020 Definitions applicable to all sections of this chapter. Unless the context indicates otherwise, words used in this chapter shall have the meaning given in this section.

(1) **"Adequate" or "effective"** means compliance with terms and intent of these standards.

(2) **"Appendix"** means references or recommendations to be used as guides in applying the provisions of this chapter.

WAC 296-62-020 (Cont.)

(3) **"Approved"** means approved by the director of the department of labor and industries or his authorized representative: Provided, however, That should a provision of this chapter state that approval by an agency or organization other than the department of labor and industries is required, such as Underwriters' Laboratories or the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health, the provision of WAC 296-24-006 shall apply.

(4) **"Authorized person"** means a person approved or assigned by the employer to perform a specific type of duty or duties or to be at a specific location or locations at the job site.

(5) **"Coal tar pitch volatiles"** as used in WAC 296-62-07515, Table I, include the fused polycyclic hydrocarbons which volatilize from the distillation residues of coal, petroleum, (excluding asphalt), wood, and other organic matter. Asphalt (CAS 8052-42-4, and CAS 64742-93-4) is not covered under the "coal tar pitch volatiles" standard.

(6) **"Competent person"** means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective action to eliminate them.

(7) **"Department"** means the department of labor and industries.

(8) **"Director"** means the director of the department of labor and industries, or his designated representative.

(9) **"Employer"** means any person, firm, corporation, partnership, business trust, legal representative, or other business entity which engages in any business, industry, profession, or activity in this state and employs one or more employees or who contracts with one or more persons, the essence of which is the personal labor of such person or persons and includes the state, counties, cities, and all municipal corporations, public corporations, political subdivisions of the state, and charitable organizations: Provided, That any persons, partnership, or business entity not having employees, and who is covered by the industrial insurance act shall be considered both an employer and an employee.

(10) **"Hazard"** means that condition, potential or inherent, which can cause injury, death, or occupational disease.

(11) **"Occupational disease"** means such disease or infection as arises naturally and proximately out of employment.

(12**)** **"Qualified"** means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated ability to solve or resolve problems relating to the subject matter, the work, or the project.

(13) **"Shall" or "must"** means mandatory.

(14) **"Should" or "may"** means recommended.

(15) **"Suitable"** means that which fits, or has the qualities or qualifications to meet a given purpose, occasion, condition, function, or circumstance.

(16) **"Worker," "personnel," "person," "employee,"** and other terms of like meaning, unless the context of the provision containing such term indicates otherwise, mean an employee of an employer who is employed in the business of their employer whether by way of manual labor or otherwise and every person in this state who is engaged in the employment of or who is working under an independent contract the essence of which is their personal labor for an employer whether by manual labor or otherwise.

WAC 296-62-020 (Cont.)

(17) **"Work place"** means any plant, yard, premises, room, or other place where an employee or employees are employed for the performance of labor or service over which the employer has the right of access or control, and includes, but is not limited to, all work places covered by industrial insurance under Title 51 RCW, as now or hereafter amended.

(18) Abbreviations used in this chapter:

(a) **"ANSI"** means American National Standards Institute.

(b) **"ASHRE"** means American Society of Heating and Refrigeration Engineers.

(c) **"BTU"** means British thermal unit.

(d) **"BTUH"** means British thermal unit per hour.

(e) **"CFM"** means cubic feet per minute.

(f) **"CFR"** means Code of Federal Register.

(g) **"CGA"** means Compressed Gas Association.

(h) **"ID"** means inside diameter.

(i) **"MCA"** means Manufacturing Chemist Association or Chemical Manufacturer Association (CMA).

(j) **"NEMA"** means National Electrical Manufacturing Association.

(k) **"NFPA"** means National Fire Protection Association.

(l) **"OD"** means outside diameter.

(m) **"WAC"** means Washington Administrative Code.

(n) **"WISHA"** means Washington Industrial Safety and Health Act (chapter 80, Laws of 1973).

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-62-020, filed 7/20/94, effective 9/20/94. Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), § 296-62-020, filed 11/30/83. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 43.22 and 42.30 RCW. 80-17-015 (Order 80-21), § 296-62-020, filed 11/13/80; Order 73-3, § 296-62-020, filed 5/7/73; Order 70-8, § 296-62-020, filed 7/31/70, effective 9/1/70; Section II, effective 8/1/63.]

WAC 296-62-040 Unconstitutionality clause. In the event that any section, paragraph, sentence, clause, phrase or work of this chapter is declared unconstitutional or invalid for any reason the remainder of said standard or this chapter shall not be affected thereby.

[Order 73-3, § 296-62-040, filed 5/7/73; Order 70-8, § 296-62-040, filed 7/31/70, effective 9/1/70; Rule 4.010, effective 8/1/63.]

WAC 296-62-050 Application for waiver or variances. See WAC 296-350-700, **Variance from WISHA rules**.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-050, filed 05/09/01, effective 09/09/01. Order 73-3, 296-62-050, filed 5/7/73; Order 70-8, § 296-62-050, filed 7/31/70, effective 9/1/70; Rule 5.010, effective 8/1/63.]

PART A-1
ERGONOMICS

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PART 1

WAC 296-62-05101 What is the purpose of this rule?

The purpose of this rule is to reduce employee exposure to specific workplace hazards that can cause or aggravate work-related musculoskeletal disorders (WMSDs). In workplaces where these hazards exist, employers must reduce them. Doing so will prevent WMSDs such as tendinitis, carpal tunnel syndrome and low back disorders. The rule is not designed to prevent injuries from slips, trips, falls, motor vehicle accidents or being struck by or caught in objects.

This rule contains three parts.

- Part 1, WAC 296-62-05105, provides a quick way for employers to know if they are covered.
- Part 2 requires covered employers to meet an employee-education requirement and identify WMSD hazards. If hazards exist, the employer must reduce them.
- Part 3 shows covered employers when they must comply with this rule. An employer's type of business and number of employees determine how much time is permitted for compliance (3 to 6 years for fixing WMSD hazards).

The rule does not include any requirements for the medical management of WMSDs or change any requirements for handling industrial insurance claims. An employer will not be in violation of this rule solely because an employee develops a WMSD or related symptom.
[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05101, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05103 Which employers are covered by this rule?

Employers with "caution zone jobs" are covered by this rule. A "caution zone job" is a job where an employee's typical work activities include any of the specific physical risk factors listed in WAC 296-62-05105.
[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05103, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05105 What is a "caution zone job?"

"Caution zone"

A "caution zone job" is a job where an employee's typical work activities include any of the specific physical risk factors listed below. Typical work activities are those that are a regular and foreseeable part of the job and occur on more than one day per week, and more frequently than one week per year.

- Employers having one or more "caution zone jobs" must comply with Part 2 of this rule. "Caution zone jobs" may not be hazardous, but do require further evaluation.
- This rule does not prohibit "caution zone jobs."
- Employers who have made a reasonable determination that they do not have "caution zone jobs" are not covered by this rule.
- Duration (for example, 2 hours) refers to the total amount of time per day employees are exposed to the risk factor, not how long they spend performing the work activity that includes the risk factor.

Awkward Posture

(1) Working with the hand(s) above the head, or the elbow(s) above the shoulder, more than 2 hours total per day

(2) Working with the neck or back bent more than 30 degrees (without support and without the ability to vary posture) more than 2 hours total per day

(3) Squatting more than 2 hours total per day

(4) Kneeling more than 2 hours total per day

High Hand Force

(5) Pinching an unsupported object(s) weighing 2 or more pounds per hand, or pinching with a force of 4 or more pounds per hand, more than 2 hours total per day (comparable to pinching half a ream of paper)

(6) Gripping an unsupported object(s) weighing 10 or more pounds per hand, or gripping with a force of 10 or more pounds per hand, more than 2 hours total per day (comparable to clamping light duty automotive jumper cables onto a battery)

Highly Repetitive Motion

(7) Repeating the same motion with the neck, shoulders, elbows, wrists, or hands (excluding keying activities) with little or no variation every few seconds more than 2 hours total per day

(8) Performing intensive keying more than 4 hours total per day

Repeated Impact

(9) Using the hand (heel/base of palm) or knee as a hammer more than 10 times per hour more than 2 hours total per day

Heavy, Frequent or Awkward Lifting

(10) Lifting objects weighing more than 75 pounds once per day or more than 55 pounds more than 10 times per day

(11) Lifting objects weighing more than 10 pounds if done more than twice per minute more than 2 hours total per day

(12) Lifting objects weighing more than 25 pounds above the shoulders, below the knees or at arms length more than 25 times per day

Moderate to High Hand-Arm Vibration

(13) Using impact wrenches, carpet strippers, chain saws, percussive tools (jack hammers, scalers, riveting or chipping hammers), or other hand tools that typically have high vibration levels, more than 30 minutes total per day

(14) Using grinders, sanders, jig saws, or other hand tools that typically have moderate vibration levels, more than 2 hours total per day

(Employers may assume that hand tools vibrating less than 2.5 meters per second squared (m/s^2) eight-hour equivalent are not covered.)

[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05105, filed 05/26/2000, effective 07/01/2002.]

PART 2

WAC 296-62-05110 When do employers' existing ergonomics activities comply with this rule?

Employers may continue to use effective alternative methods established before this rule's adoption date. If used, the employer must be able to demonstrate that the alternative methods, taken as a whole, are as effective as the requirements of this rule in reducing the WMSD hazards of each job and providing for employee education, training and participation.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05110, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05120 Which employees must receive ergonomics awareness education and when?

(1) Employers must ensure that all employees working in or supervising "caution zone jobs" receive ergonomics awareness education at least once every three years. The employer may provide ergonomics awareness education or may rely on education provided by another employer or organization. Ergonomics awareness education materials provided by the department of labor and industries may be used to meet these requirements.

(2) When employees are assigned to work in or supervise "caution zone jobs," they must receive ergonomics awareness education within 30 calendar days, unless they have received it in the past three years. This requirement applies when the initial "awareness education" deadline in the implementation schedule (WAC 296-62-05160) has passed.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05120, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05122 What must be included in ergonomics awareness education?

Ergonomics awareness education (for example: Oral presentations, videos, computer-based presentations, or written materials with discussion) must include:

- Information on work-related causes of musculoskeletal disorders, including all caution zone risk factors listed in WAC 296-62-05105 (nonwork factors may be included as well);
- The types, symptoms and consequences of WMSDs and the importance of early reporting;
- Information on identifying WMSD hazards and common measures to reduce them; and
- The requirements of this ergonomics rule.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05122, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05130 What options do employers have for analyzing and reducing WMSD hazards?

All covered employers must determine whether "caution zone jobs" have WMSD hazards and must reduce the WMSD hazards identified as described below.

Employers may choose either the General Performance Approach or the Specific Performance Approach as follows:

WAC 296-62-05130 – Analyzing and reducing WMSD hazards: General Performance Approach	**WAC 296-62-05130 – Analyzing and reducing WMSD hazards: Specific Performance Approach**
(1) The employer must analyze "caution zone jobs" to identify those with WMSD hazards that must be reduced. A WMSD hazard is a physical risk factor that by itself or in combination with other physical risk factors has a sufficient level of intensity, duration or frequency to cause a substantial risk of WMSDs. The employer must use hazard control levels as effective as the recommended levels in widely used methods such as, the Job Strain Index, the lifting guidelines in the Department of Energy ErgoEASER, the ANSI S3.34-1986 (R1997) Hand Arm Vibration Standards, the 1991 NIOSH Lifting Equation, (as described in Waters 1993), the UAW-GM Risk Factor Checklists, applicable ACGIH threshold limit values for physical agents, Rapid Entire Body Assessment (REBA), or Rapid Upper Limb Assessment (RULA).	(1) The employer must analyze "caution zone jobs" to identify those with WMSD hazards that must be reduced. A WMSD hazard is a physical risk factor that exceeds the criteria in Appendix B of this rule.
(2) The employer must analyze "caution zone jobs" using a systematic method that includes the following, if applicable: • Physical demands specific to the worksite including posture, force, repetition, repeated impacts, hand-arm vibration, duration, work pace, task variability, and recovery time; • Layout of the work area, including reaches, working heights, seating and surfaces; and • Manual handling requirements, including size, shape, weight, and packaging.	(2) Same as General Performance Approach
(3) Individuals responsible for hazard analysis must know how to use the analysis method effectively and be informed about the requirements of this rule.	(3) Individuals responsible for hazard analysis must know how to use the analysis provided in Appendix B effectively and be informed about the requirements of this rule.
(4) The employer must reduce all WMSD hazards below the criteria chosen in WAC 296-62-05130(1) or to the degree technologically and economically feasible.	(4) The employer must reduce all WMSD hazards below the criteria in Appendix B of this rule or to the degree technologically and economically feasible.

WAC 296-62-05130 (Cont.)

WAC 296-62-05130 –Analyzing and reducing WMSD hazards: General Performance Approach (cont.)	WAC 296-62-05130 – Analyzing and reducing WMSD hazards: Specific Performance Approach (cont.)
(5) Employers must reduce WMSD hazards as described below by: (a) Implementing controls that do not rely primarily on employee behavior to reduce WMSD hazards, such as the following: • Changes to workstations and tools • Reducing the size and weights of loads handled • Process redesign to eliminate unnecessary steps or introduce task variety • Job rotation (b) If employers cannot reduce WMSD hazards below the hazard level using the controls identified above, they must supplement those controls with interim measures that primarily rely on individual work practices or personal protective equipment. Examples of such practices include the following: • Impact gloves • Team lifting • Training on work techniques (c) This rule does not require an employer to control WMSD hazards by replacing full-time employees with part-time employees or otherwise reducing an individual's hours of employment. If an employer has implemented all other technologically and economically feasible controls, and a WMSD hazard remains, the employer will be deemed in compliance with this subsection.	(5) Same as General Performance Approach
(6) If measures to reduce WMSD hazards include changes in the job or work practices then job-specific training must be provided. This job-specific training must include: • The hazards of the work activities; • Safe work practices; and • The proper use and maintenance of specific measures to reduce WMSD hazards that have been implemented.	(6) Same as General Performance Approach
(7) No written ergonomics program is required. The employer must be able to demonstrate the following: • The method used to analyze "caution zone jobs"; • The criteria used to identify WMSD hazards; • The jobs with identified WMSD hazards; and • The reduction of all WMSD hazards below the criteria chosen in WAC 296-62-05130(1) or to the degree technologically and economically feasible.	(7) No written ergonomics program is required. The employer must be able to demonstrate that all WMSD hazards have been reduced below the criteria identified in Appendix B of this rule or to the degree technologically and economically feasible.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05130, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05140 How must employees be kept involved and informed?

(1) The employer must provide for and encourage employee participation in analyzing "caution zone jobs" and selecting measures to reduce WMSD hazards. Employers with eleven or more employees who are required to have safety committees (WAC 296-24-045) must involve this committee in choosing the methods to be used for employee participation.

(2) Employers with eleven or more employees must share the following information with the safety committee (if a committee is required by WAC 296-24-045). Employers who are not required to have a safety committee (WAC 296-24-045) must provide this information at safety meetings:

- The requirements of this rule;
- Identified "caution zone jobs";
- Results of the hazard analysis and/or identification of jobs with WMSD hazards; and
- Measures to reduce WMSD hazards.

(3) The employer must review its ergonomics activities at least annually for effectiveness and for any needed improvements. This review must include members of the safety committee where one exists or ensure an equally effective means of employee involvement.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05140, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05150 How are terms and phrases used in this rule?

Note: Check L&I's WISHA Services web site at http://www.lni.wa.gov/wisha/ergo for current links to any of the web sites referred to in this section.

ACGIH threshold limit values for physical hazards - The American Conference of Governmental Industrial Hygienists, Thresholds Limit Values for Chemical Substances and Physical Agents in the Work Environment, and Biological Exposure Indices (TLVs and BEIs). Available for purchase at the ACGIH web site at http://www.acgih.org.

ANSI S3.34-1986 (R1997) Hand Arm Vibration Standards - American National Standard Guide for the Measurement and Evaluation of Human Exposure to Vibration Transmitted to the Hand. ANSI S3.34-1986 (R1997). Available for purchase at the ANSI web site at http://web.ansi.org/default.htm.

"Caution zone jobs" - Jobs where an employee's typical work activities include any of the specific physical risk factors identified in WAC 296-62-05105. These jobs have a sufficient degree of risk to require ergonomics awareness education and job hazard analysis.

Department of Energy ErgoEASER - Ergonomics Education, Awareness, System Evaluation and Recording (ErgoEASER) software package. U. S. Department of Energy, Office of Environment, Safety, and Health (1995). Can be downloaded from the Department of Energy web site at http://tis.eh.doe.gov/others/ergoeaser/download.htm.

Ergonomics – The science and practice of designing jobs or workplaces to match the capabilities and limitations of the human body.

Full Time Equivalent (FTE) – The equivalent of one person working full-time for one year (2,000 worker hours per year). For example, two persons working half time count as one FTE.

High Hand-Arm Vibration Levels - Tools with vibration values equal to or greater than 10 meters per second squared (m/s^2) eight-hour equivalent. Examples include some impact wrenches, carpet strippers, chain saws, and percussive tools.

Intensive Keying – Keying with the hands or fingers in a rapid, steady motion with few opportunities for temporary work pauses.

Job Strain Index - The Strain Index: A proposed method to analyze jobs for risk of distal upper extremity disorders, Moore, J.S., and A. Garg, (1995). Published in American Industrial Hygiene Association Journal, volume 56, pages 443-458.Web site at http://sg-www.satx.disa.mil/hscoemo/tools/strain.htm.

WAC 296-62-05150 (Cont.)

Moderate Hand-Arm Vibration Levels – Tools with vibration values between 2.5 and 10 meters per second squared (m/s^2) eight-hour equivalent. Examples include some grinders, sanders, and jig saws.

NIOSH Lifting Equation, 1991 – Waters, T.R., Putz-Anderson, V., Garg, A., and Fine, L.J. (1993). Revised NIOSH equation for the design and evaluation of manual lifting tasks. Published in Ergonomics, volume 36 (7), pages 749-776. For a manual on using the lifting equation see: Applications Manual for Revised Lifting Equation, Waters, T., Putz-Anderson, V., Garg, A. (1994). Available from the National Technical Information Center (NTIS), Springfield, VA 22161. 1-800-553-6847.
Calculator web site at http://www.industrialhygiene.com/calc/lift.html.
Application guideline web site: http://www.cdc.gov/niosh/94-110.html.

Rapid Entire Body Assessment tool (REBA) - Hignett, S. and McAtamney, L. (2000) Rapid entire body assessment (REBA). Published in Applied Ergonomics volume 31, pages 201-205.

Recovery Time – Work periods with light task demands, or rest breaks, that permit an employee to recover from physically demanding work.

The Rapid Upper Limb Assessment (RULA) - McAtamney, L. and Corlett, E.N. (1993) RULA: A survey method for the investigation of work-related upper limb disorders. Published in Applied Ergonomics, volume 24 (2), pages 91-99.

UAW-GM Risk Factor Checklists - UAW-GM Risk Factor Checklist 2, 1998. UAW-GM (United Auto Workers-General Motors), Center for Human Resources, Health and Safety Center, 1030 Doris Road, Auburn Hills, Michigan.

Work Activities – The physical demands, exertions, or functions of the job or task.

Work-Related Musculoskeletal Disorders (WMSDs) – Work-related disorders that involve soft tissues such as muscles, tendons, ligaments, joints, blood vessels and nerves. Examples include: Muscle strains and tears, ligament sprains, joint and tendon inflammation, pinched nerves, degeneration of spinal discs, carpal tunnel syndrome, tendinitis, rotator cuff syndrome. For purposes of this rule WMSDs do not include injuries from slips, trips, falls, motor vehicle accidents or being struck by or caught in objects.
[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05150, filed 05/26/2000, effective 07/01/2002.]

PART 3

WAC 296-62-05160 When must employers comply with this rule?

Employers covered by this rule must comply with its requirements by the dates shown.

INITIAL IMPLEMENTATION SCHEDULE		
Employer	**Awareness Education Completed And Hazard Analysis Completed**	**Hazard Reduction Completed**
• All employers in SIC codes* 078, 152, 174, 175, 176, 177, 242, 421, 451, 541, 805, and 836 who employ 50 or more annual full time equivalents (FTEs) in Washington state • The Washington State Department of Labor & Industries	July 1, 2002	July 1, 2003
• The remaining employers in SIC codes* 078, 152, 174, 175, 176, 177, 242, 421, 451, 541, 805 and 836 • All other employers who employ 50 or more annual full time equivalents (FTEs) in Washington state	July 1, 2003	July 1, 2004

WAC 296-62-05160 (Cont.)

All other employers employing 11-49 annual full time equivalents (FTEs) in Washington state	July 1, 2004	July 1, 2005
All other employers employing 10 or fewer annual full time equivalents (FTEs) in Washington state	July 1, 2005	July 1, 2006
SUPPLEMENTAL IMPLEMENTATION SCHEDULE		
New workplaces or businesses	One year from the date the new workplace or business is established OR According to the schedule above	15 months from the date the new workplace or business is established OR According to the schedule above
Significant changes to existing workplaces or businesses	2 months after significant changes occur OR According to the schedule above	3 months after significant changes occur OR According to the schedule above

**Note: SIC code is the employer's primary SIC based on hours of employment. See Appendix C of this rule for descriptions of these SIC codes*

Note: Help for employers in implementing the rule.

(1) Developing Ergonomics Guides and Models
The department will work with employer and employee organizations to develop guides for complying with this rule (for example, a model program for ergonomics awareness education). Employer use of these guides will be optional.

(2) Identifying Industry "Best Practices"
The department will work with employer and employee organizations to develop or identify methods of reducing WMSD hazards that will serve as examples of industry-specific "best practices." As industry-specific "best practices" are developed, they may be used to demonstrate employer compliance with the requirement to reduce WMSD hazards. Employers will not be restricted to the use of industry "best practices" for compliance.

(3) Establishing Inspection Policies and Procedures
The department will develop policies and procedures for inspections and enforcement of this rule before the rule is enforced. These policies and procedures will be communicated to employers and employees through mailing lists, business associations, labor unions and other methods before the department issues any citations or penalties.

(4) Conducting Demonstration Projects
Following adoption of this rule, the department will work with employers and employees to undertake demonstration projects to test and improve guidelines, "best practices" and inspection policies and procedures as they are developed.

(5) Providing Information on Ergonomics
The department will work with employer and employee organizations to collect and share the most effective examples of ergonomics training, job analysis, and specific solutions to problems. The department will make special efforts to share this information with the small business community.

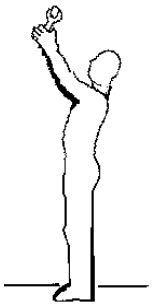
[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05160, filed 05/26/2000, effective 07/01/2002.]

WAC 296-62-05172 Appendix A: Illustrations of physical risk factors

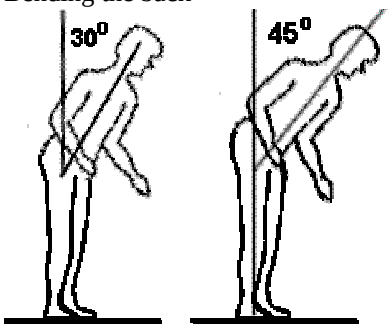
The following illustrations are provided as reference only. Some users of this rule may find the pictures aid their understanding of the text in WAC 296-62-05105.

Awkward Postures

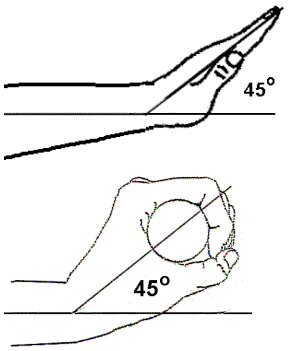
Raising the hands above the head



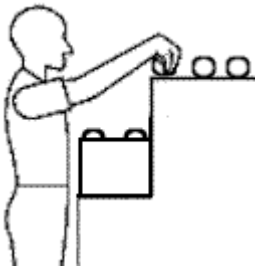
Bending the back



Bending the wrist
Extension

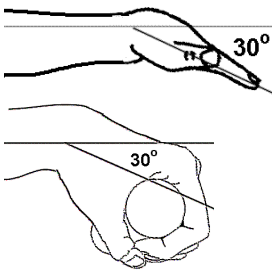


Raising the elbows above the shoulders

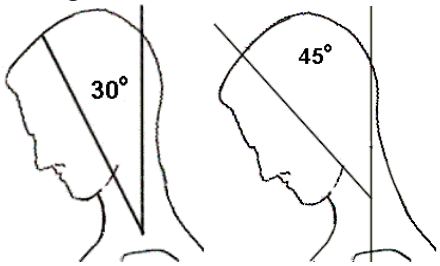


Squatting

Flexion

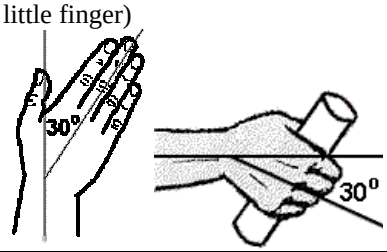


Bending the neck



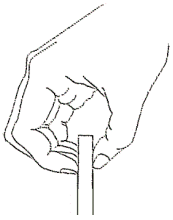
Kneeling

Ulnar deviation (bent towards the little finger)

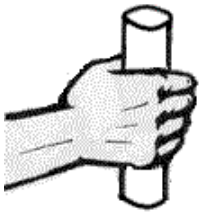


High Hand Force

Pinching 2 lbs.



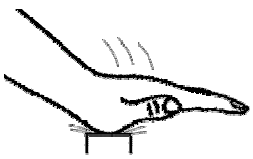
Gripping 10 lbs.



Repeated Impacts

Using the knee as a hammer

Using the hand as a hammer



[Statutory Authority: RCW 49.17.010, .040, .050. 00-12-024 (Order 98-36), § 296-62-05172, filed 05/26/2000, effective 07/01/2002.]

PART B
ACCESS TO RECORDS

WAC

WAC 296-62-052 Access to employee exposure and medical records.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-052, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-052, filed 8/27/81.]

WAC 296-62-05201 Purpose. The purpose of this section is to provide employees and their designated representatives a right of access to relevant exposure and medical records, and to provide representatives of the director of labor and industries a right of access to these records in order to fulfill responsibilities under the Washington Industrial Safety and Health Act. Access by employees, their representatives, and the director of labor and industries is necessary to yield both direct and indirect improvements in the detection, treatment and prevention of occupational disease. Each employer is responsible for assuring compliance with this section, but the activities involved in complying with the access to medical records provisions can be carried out, on behalf of the employer, by the physician or other health care personnel in charge of employee medical records. Except as expressly provided, nothing in this section is intended to affect existing legal and ethical obligations concerning the maintenance and confidentiality of employee medical information, the duty to disclose information to a patient/employee or any other aspect of the medical-care relationship, or affect existing legal obligations concerning the protection of trade secret information.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05201, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05201, filed 8/27/81.]

WAC 296-62-05203 Scope and application.

(1) This section applies to every employer, except as provided in subsection (4) of this section, who makes, maintains, contracts for, or has access to employee exposure or medical records, or analyses thereof, pertaining to employees exposed to toxic substances or harmful physical agents.

(2) This section applies to all employee exposure and medical records, and analyses thereof, of such employees, whether or not the records are mandated by specific occupational safety and health standards.

(3) This section applies to all employee exposure and medical records, and analyses thereof, made or maintained in any manner, including on an in-house or contractual (e.g., fee-for-service) basis. Each employer shall assure that the preservation and access requirements of this section are complied with regardless of the manner in which records are made or maintained.

(4) This section does not apply to the agricultural operations covered by chapter 296-306 WAC.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05203, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05203, filed 8/27/81.]

WAC 296-62-05205 Definitions.

(1) **Access** - the right and opportunity to examine and copy.

(2) **Analysis using exposure or medical records** - any compilation of data, or any statistical study based at least in part on information collected from individual employee exposure or medical records or information collected from health insurance claims records, provided that either the analysis has been reported to the employer or no further work is currently being done by the person responsible for preparing the analysis.

(3) **Designated representative** - any individual or organization to whom an employee gives written authorization to exercise a right of access. For the purposes of access to employee exposure records and analyses using exposure or medical records, a recognized or certified collective bargaining agent shall be treated automatically as a designated representative without regard to written employee authorization.

(4) **Employee** - a current employee, a former employee, or an employee being assigned or transferred to work where there will be exposure to toxic substances or harmful physical agents. In the case of a deceased or legally incapacitated employee, the employee's legal representative may directly exercise all the employee's rights under this section.

(5) **Employee exposure record** - a record containing any of the following kinds of information:

(a) Environmental (workplace) monitoring or measuring of a toxic substance or harmful physical agent, including personal, area, grab, wipe, or other form of sampling, as well as related collection and analytical methodologies, calculations, and other background data relevant to interpretation of the results obtained;

(b) Biological monitoring results which directly assess the absorption of a toxic substance or harmful physical agent by body systems (e.g., the level of a chemical in the blood, urine, breath, hair, fingernails, etc.) but not including results which assess the biological effect of a substance or agent or which assess an employee's use of alcohol or drugs;

(c) Material safety data sheets indicating that the material may pose a hazard to human health; or

(d) In the absence of the above, a chemical inventory or any other record which reveals where and when used and the identity (e.g., chemical, common or trade name) of a toxic substance or harmful physical agent.

(6) (a) **Employee medical record** - a record concerning the health status of an employee which is made or maintained by a physician, nurse, or other health care personnel, or technician, including:

(i) Medical and employment questionnaires or histories (including job description and occupational exposures);

(ii) The results of medical examinations (preemployment, pre-assignment, periodic, or episodic) and laboratory tests (including chest and other x-ray examinations taken for purposes of establishing a base-line or detecting occupational illness, and all biological monitoring not defined as an “employee exposure record”);

(iii) Medical opinions, diagnoses, progress notes, and recommendations;

(iv) First-aid records;

(v) Descriptions of treatments and prescriptions; and

WAC 296-62-05205 (Cont.)

(vi) Employee medical complaints.

(b) Employee medical record does not include medical information in the form of:

(i) Physical specimens (e.g., blood or urine samples) which are routinely discarded as a part of normal medical practice; or

(ii) Records concerning health insurance claims if maintained separately from the employer's medical program and its records, and not accessible to the employer by employee name or other direct personal identifier (e.g., Social Security number, payroll number, etc.); or

(iii) Records created solely in preparation for litigation which are privileged from discovery under applicable rules or procedure or evidence; or

(iv) Records concerning voluntary employee assistance programs (alcohol, drug abuse, or personal counseling programs) if maintained separately from the employer's medical program and its records.

(7) **Employer** - a current employer, a former employer or a successor employer.

(8) **Exposure or exposed** - an employee is subjected to a toxic substance or harmful physical agent in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.), and includes past exposure and potential (e.g., accidental or possible) exposure, but does not include situations where the employer can demonstrate that the toxic substance or harmful physical agent is not used, handled, stored, generated, or present in the workplace in any manner different from typical nonoccupational situations.

(9) **Health professional** - a physician, occupational health nurse, industrial hygienist, toxicologist, or epidemiologist, providing medical or other occupational health services to exposed employees.

(10) **Record** - any item, collection, or grouping of information regardless of the form or process by which it is maintained (e.g., paper document, microfiche, microfilm, x-ray film, or automated data processing).

(11) **Specific chemical identity** - the chemical name, chemical abstracts service (CAS) registry number, or any other information that reveals the precise chemical designation of the substance.

(12) (a) **Specific written consent** - a written authorization containing the following:

(i) The name and signature of the employee authorizing the release of medical information;

(ii) The date of the written authorization;

(iii) The name of the individual or organization that is authorized to release the medical information;

(iv) The name of the designated representative (individual or organization) that is authorized to receive the released information;

(v) A general description of the medical information that is authorized to be released;

(vi) A general description of the purpose for the release of the medical information; and

WAC 296-62-05205 (Cont.)

(vii) A date or condition upon which the written authorization will expire (if less than one year).

(b) A written authorization does not operate to authorize the release of medical information not in existence on the date of written authorization, unless the release of future information is expressly authorized, and does not operate for more than one year from the date of written authorization.

(c) A written authorization may be revoked in writing prospectively at any time.

(13) **Toxic substance or harmful physical agent** - any chemical substance, biological agent (bacteria, virus, fungus, etc.), or physical stress (noise, heat, cold, vibration, repetitive motion, ionizing and nonionizing radiation, hypo- or hyperbaric pressure, etc.) which:

(a) Is listed in the latest printed edition of the National Institute for Occupational Safety and Health (NIOSH) Registry of Toxic Effects of Chemical Substances (RTECS) (See Appendix B); or

(b) Has yielded positive evidence of an acute or chronic health hazard in testing conducted by, or known to, the employer; or

(c) Is the subject of a material safety data sheet kept by or known to the employer indicating that the material may pose a hazard to human health.

(14) **Trade secret** - any confidential formula, pattern, process, device, or information or compilation of information that is used in an employer's business and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05205, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05205, filed 8/27/81.]

WAC 296-62-05207 Preservation of records.

(1) Unless a specific occupational safety and health standard provides a different period of time, each employer shall assure the preservation and retention of records as follows:

(a) Employee medical records. The medical record for each employee shall be preserved and maintained for at least the duration of employment plus thirty years, except that the following types of records need not be retained for any specific period:

(i) Health insurance claims records maintained separately from the employer's medical program and its records;

(ii) First-aid records (not including medical histories) of one-time treatment and subsequent observation of minor scratches, cuts, burns, splinters, and the like which do not involve medical treatment, loss of consciousness, restriction of work or motion, or transfer to another job, if made on-site by a nonphysician and if maintained separately from the employer's medical program and its records; and

(iii) The medical records of employees who have worked for less than one year for the employer need not be retained beyond the term of employment if they are provided to the employee upon the termination of employment.

(b) Employee exposure records. Each employee exposure record shall be preserved and maintained for at least thirty years, except that:

WAC 296-62-05207 (Cont.)

(i) Background data to environmental (workplace) monitoring or measuring, such as laboratory reports and worksheets, need only be retained for one year as long as the sampling results, the collection methodology (sampling plan), a description of the analytical and mathematical methods used, and a summary of other background data relevant to interpretation of the results obtained, are retained for at least thirty years; and

(ii) Employee exposure records concerning the identity of a substance or agent need not be retained for any specified period as long as some record of the identity (chemical name if known) of the substance or agent, where it was used, and when it was used is retained for at least thirty years; and

(iii) Biological monitoring results designated as exposure records by specific occupational safety and health standards shall be preserved and maintained as required by the specific standard.

(c) Analyses using exposure or medical records. Each analysis using exposure or medical records shall be preserved and maintained for at least thirty years.

(2) Nothing in this section is intended to mandate the form, manner, or process by which an employer preserves a record as long as the information contained in the record is preserved and retrievable, except that chest x-ray films shall be preserved in their original state.

[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-05207, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05207, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05207, filed 8/27/81.]

WAC 296-62-05209 Access to records.

(1) **General.**

(a) Whenever an employee or designated representative requests access to a record, the employer shall assure that access is provided in a reasonable time, place, and manner. If the employer cannot reasonably provide access to the record within fifteen working days, the employer shall within fifteen working days apprise the employee or designated representative requesting the record of the reason for the delay and the earliest date when the record can be made available.

(b) The employer may require of the requester only such information as should be readily known to the requester and which may be necessary to locate or identify the records being requested (e.g., dates and locations where the employee worked during the time period in question).

(c) Whenever an employee or designated representative requests a copy of a record, the employer shall assure that either:

(i) A copy of the record is provided without cost to the employee or representative;

(ii) The necessary mechanical copying facilities (e.g., photocopying) are made available without cost to the employee or representative for copying the record;

(iii) The record is loaned to the employee or representative for a reasonable time to enable a copy to be made; or

(iv) In the case of an original x-ray, the employer may restrict access to on-site examination or make other suitable arrangements for the temporary loan of the x-ray.

WAC 296-62-05209 (Cont.)

(d) Whenever a record has been previously provided without cost to an employee or designated representative, the employer may charge reasonable, nondiscriminatory administrative costs (i.e., search and copying expenses but not including overhead expenses) for a request by the employee or designated representative for additional copies of the record, except that:

(i) An employer shall not charge for an initial request for a copy of new information that has been added to a record which was previously provided; and

(ii) An employer shall not charge for an initial request by a recognized or certified collective bargaining agent for a copy of an employee exposure record or an analysis using exposure or medical records.

(e) Nothing in this section is intended to preclude employees and collective bargaining agents from collectively bargaining to obtain access to information in addition to that available under this section.

(2) **Employee and designated representative access.**

(a) Employee exposure records. Except as limited by WAC 296-62-053 each employer shall, upon request, assure the access of each employee and designated representative to employee exposure records relevant to the employee. For the purpose of this section, an exposure record relevant to the employee consists of:

(i) A record which measures or monitors the amount of a toxic substance or harmful physical agent to which the employee is or has been exposed;

(ii) In the absence of such directly relevant records, such records of other employees with past or present job duties or working conditions related to or similar to those of the employee to the extent necessary to reasonably indicate the amount and nature of the toxic substances or harmful physical agents to which the employee is or has been subjected; and

(iii) Exposure records to the extent necessary to reasonably indicate the amount and nature of the toxic substances or harmful physical agents at workplaces or under working conditions to which the employee is being assigned or transferred.

(iv) Requests by designated representatives for unconsented access to employee exposure records shall be in writing and shall specify with reasonable particularity:

(A) The records requested to be disclosed; and

(B) The occupational health need for gaining access to these records.

(b) Employee medical records.

(i) Each employer shall, upon request, assure the access of each employee to employee medical records of which the employee is the subject, except as provided in (b)(iv) of this subsection.

(ii) Each employer shall, upon request, assure the access of each designated representative to the employee medical records of any employee who has given the designated representative specific written consent. Appendix A to this section contains a sample form which may be used to establish specific written consent for access to employee medical records.

WAC 296-62-05209 (Cont.)

(iii) Whenever access to employee medical records is requested, a physician representing the employer may recommend that the employee or designated representative:

(A) Consult with the physician for the purposes of reviewing and discussing the records requested;

(B) Accept a summary of material facts and opinions in lieu of the records requested; or

(C) Accept release of the requested records only to a physician or other designated representative.

(iv) Whenever an employee requests access to his or her employee medical records, and a physician representing the employer believes that direct employee access to information contained in the records regarding a specific diagnosis of a terminal illness or a psychiatric condition could be detrimental to the employee's health, the employer may inform the employee that access will only be provided to a designated representative of the employee having specific written consent, and deny the employee's request for direct access to this information only. Where a designated representative with specific written consent requests access to information so withheld, the employer shall assure the access of the designated representative to this information, even when it is known that the designated representative will give the information to the employee.

(v) A physician, nurse, or other responsible health care personnel maintaining employee medical records may delete from requested medical records the identity of a family member, personal friend, or fellow employee who has provided confidential information concerning an employee's health status.

(c) Analyses using exposure or medical records.

(i) Each employer shall, upon request, assure the access of each employee and designated representative to each analysis using exposure or medical records concerning the employee's working conditions or workplace.

(ii) Whenever access is requested to an analysis which reports the contents of employee medical records by either direct identifier (name, address, social security number, payroll number, etc.) or by information which could reasonably be used under the circumstances indirectly to identify specific employees (exact age, height, weight, race, sex, date of initial employment, job title, etc.) the employer shall assure that personal identifiers are removed before access is provided. If the employer can demonstrate that removal of personal identifiers from an analysis is not feasible, access to the personally identifiable portions of the analysis need not be provided.

(3) **Department access.**

(a) Each employer shall upon request, and without derogation of any rights under the Constitution or the Washington Industrial Safety and Health Act, that the employer chooses to exercise, assure the prompt access of representatives of the director of the department of labor and industries to employee exposure and medical records and to analyses using exposure or medical records. Rules of agency practice and procedures governing WISHA access to employee medical records are contained in this chapter.

WAC 296-62-05209 (Cont.)

(b) Whenever the department seeks access to personally identifiable employee medical information by presenting to the employer a written access order, the employer shall prominently post a copy of the written access order and its accompanying cover letter for at least fifteen working days.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05209, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), § 296-62-05209, filed 11/30/83. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05209, filed 8/27/81.]

WAC 296-62-05213 Employee information.

(1) Upon an employee's first entering into employment, and at least annually thereafter, each employer shall inform current employees covered by this section of the following:

(a) The existence, location and availability of any records covered by this section;

(b) The person responsible for maintaining and providing access to records; and

(c) Each employee's rights of access to these records.

(2) Each employer shall keep a copy of this standard and its appendices, and make copies readily available upon request, to employees. The employer shall also distribute to current employees any informational materials concerning this section which are made available to the employer by the director for the Washington industrial safety and health division.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05213, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05213, filed 8/27/81.]

WAC 296-62-05215 Transfer of records.

(1) Whenever an employer is ceasing to do business, the employer shall transfer all records subject to this section to the successor employer. The successor employer shall receive and maintain these records.

(2) Whenever an employer is ceasing to do business and there is no successor employer to receive and maintain the records subject to this standard, the employer shall notify affected current employees of their rights of access to records at least three months prior to the cessation of the employer's business.

(3) Whenever an employer either is ceasing to do business and there is no successor employer to receive and maintain the records, or intends to dispose of any records required to be preserved for at least thirty years, the employer shall:

(a) Transfer the records to the director of the department of labor and industries if so required by a specific industrial safety and health standard; or

(b) Notify the director of the department of labor and industries in writing of the impending disposal of records at least three months prior to the disposal of the records.

(4) Where an employer regularly disposes of records required to be preserved for at least thirty years, the employer may, with at least three months notice, notify the director of the department of labor and industries on an annual basis of the records intended to be disposed of in the coming year.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05215, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05215, filed 8/27/81.]

WAC 296-62-05217 Appendices. The information contained in the appendices A and B to this section is not intended, by itself, to create any additional obligations not otherwise imposed by this section nor detract from any existing obligation.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05217, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05217, filed 8/27/81.]

WAC 296-62-05219 Effective date. WAC 296-62-052 through 296-62-05223 shall become effective June 30, 1989.

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05219, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05219, filed 8/27/81.]

WAC 296-62-05221 Appendix A--Sample authorization letter for the release of employee medical record information to a designated representative.(Nonmandatory.)

I, _____ (full name of worker/patient) hereby authorize _____(individual or organization holding the medical records) to release to _____ (individual or organization authorized to receive the medical information), the following medical information from my personal medical records:

_____

_____

(Describe generally the information desired to be released.)

I give my permission for this medical information to be used for the following purpose: _____, but I do not give permission for any other use or re-disclosure of this information.

(Note: Several extra lines are provided below so that you can place additional restrictions on this authorization letter if you want to. You may, however, leave these lines blank. On the other hand, you may want to (1) specify a particular expiration date for this letter (if less than one year); (2) describe medical information to be created in the future that you intend to be covered by this authorization letter; or (3) describe portions of the medical information in your records which you do not intend to be released as a result of this letter.)

_____

_____

_____

_____

Full Name of Employee or Legal Representative

_____

Signature of Employee or Legal Representative

_____

Date of Signature

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05221, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05221, filed 8/27/81.]

WAC 296-62-05223 Appendix B--Availability of NIOSH Registry of Toxic Effects of Chemical Substances (RTECS)--(Nonmandatory.)

WAC 296-62-052 applies to all employee exposure and medical records, and analyses thereof, of employees exposed to toxic substances or harmful physical agents (WAC 296-62-05203). The term "toxic substance or harmful physical agent" is defined by WAC 296-62-05205(11) to encompass chemical substances, biological agents, and physical stresses for which there is evidence of harmful health effects. The standard uses the latest printed edition of the National Institute for Occupational Safety and Health (NIOSH) Registry of Toxic Effects of Chemical Substances (RTECS) as one of the chief sources of information as to whether evidence of harmful health effects exists. If a substance is listed in the latest printed RTECS, the standard applies to exposure and medical records (and analyses of these records) relevant to employees exposed to the substance.

It is appropriate to note that the final standard does not require that employers purchase a copy of RTECS, and many employers need not consult RTECS to ascertain whether their employee exposure or medical records are subject to the standard. Employers who do not currently have the latest printed edition of the NIOSH RTECS, however, may desire to obtain a copy. The RTECS is issued in an annual printed edition as mandated by section

20(a)(6) of the Occupational Safety and Health Act (29 U.S.C. 669(a)(6)). The introduction to the 1980 printed edition describes the RTECS as follows:

WAC 296-62-05223 (Cont.)

"The 1980 edition of the Registry of Toxic Effects of Chemical Substances, formerly known as the Toxic Substances List, is the ninth revision prepared in compliance with the requirements of Section 20(a)(6) of the Occupational Safety and Health Act of 1970 (Public Law 91-596). The original list was completed on June 28, 1971, and has been updated annually in book format. Beginning in October 1977, quarterly revisions have been provided in microfiche. This edition of the Registry contains 168,096 listings of chemical substances: 45,156 are names of different chemicals with their associated toxicity data and 122,940 are synonyms. This edition includes approximately 5,900 new chemical compounds that did not appear in the 1979 Registry." (p.xi)

"The Registry's purposes are many, and it serves a variety of users. It is a single source document for basic toxicity information and for other data, such as chemical identifiers and information necessary for the preparation of safety directives and hazard evaluations for chemical substances. The various types of toxic effects linked to literature citations provide researchers and occupational health scientists with an introduction to the toxicological literature, making their own review of the toxic hazards of a given substance easier. By presenting data on the lowest reported doses that produce effects by several routes of entry in various species, the Registry furnishes valuable information to those responsible for preparing safety data sheets for chemical substances in the workplace. Chemical and production engineers can use the Registry to identify the hazards which may be associated with chemical intermediates in the development of final products, and thus can more readily select substitutes or alternative processes which may be less hazardous. Some organizations, including health agencies and chemical companies, have included the NIOSH Registry accession numbers with the listing of chemicals in their files to reference toxicity information associated with those chemicals. By including foreign language chemical names, a start has been made toward providing rapid identification of substances produced in other countries." (p.xi)

"In this edition of the Registry, the editors intend to identify "all known toxic substances" which may exist in the environment and to provide pertinent data on the toxic effects from known doses entering an organism by any route described." (p.xi)

"It must be reemphasized that the entry of a substance in the Registry does not automatically mean that it must be avoided. A listing does mean, however, that the substance has the documented potential of being harmful if misused, and care must be exercised to prevent tragic consequences. Thus, the Registry lists many substances that are common in everyday life and are in nearly every household in the United States. One can name a variety of such dangerous substances: Prescription and nonprescription drugs; food additives; pesticide concentrates, sprays, and dusts; fungicides; herbicides; paints; glazes, dyes; bleaches and other household cleaning agents; alkalies; and various solvents and diluents. The list is extensive because chemicals have become an integral part of our existence."

The RTECS printed edition may be purchased from the Superintendent of Documents, U.S. Government Printing Office (GPO), Washington, DC 20402 (202-783-3238).

Some employers may desire to subscribe to the quarterly update to the RTECS which is published in a microfiche edition. An annual subscription to the quarterly microfiche may be purchased from the GPO (Order the "Microfiche Edition, Registry of Toxic Effects of Chemical Substances"). Both the printed edition and the microfiche edition of RTECS are available for review at many university and public libraries throughout the country. The latest RTECS editions may also be examined at the OSHA Technical Data Center, Room N2439--Rear, United States Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210 (202-523-9700), or at any OSHA Regional or Area Office (See, major city telephone directories under United States Government-Labor Department)."

[Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), § 296-62-05223, filed 5/15/89, effective 6/30/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-05223, filed 8/27/81.]

PART B-1
TRADE SECRETS

WAC

WAC 296-62-05305 Meet certain conditions if you withhold trade secret information. You may withhold the specific chemical identify, including the chemical name and other specific identification of a toxic substance or hazardous chemical, from a disclosable record or a material safety data sheet if you meet each of the following conditions:

You:

- Can support the claim that the information withheld is a trade secret.
- Disclose all other available information about the properties and effects of the toxic substance.
- Disclose the information in the material safety data sheet about the properties and effects of the hazardous chemical.
- Inform the person requesting the information, or the material safety data sheet states that the specific chemical identity is being withheld as a trade secret.
- Make available the specific chemical identity to health professionals, employees, and their designated representatives according to the provisions of this rule.

Nothing in this rule hinders an employer from deleting from records requested by a health professional, employee, or designated representative any trade secret data which discloses manufacturing processes, or discloses the percentage of a chemical substance in a mixture.

You must notify the health professional, employee, or designated representative requesting records that information about the trade has been deleted from the records.

If deleting trade secret information from a record substantially impairs evaluation of the location or the time when exposure to a toxic substance occurred, you must provide alternative information that enables the requesting party to identify where and when the exposure occurred.
[Statutory Authority: RCW 47.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-05305, filed 05/09/01, effective 09/01/01.

WAC 296-62-05310 Reveal trade secret information when it is needed in order to treat a medical or first-aid emergency. When a physician or nurse treating a patient determines that a medical emergency exists and the specific chemical identity of a toxic substance or hazardous chemical is necessary for emergency or first-aid treatment, you must immediately disclose the specific chemical identity of a trade secret chemical to the treating physician or nurse.

You must do this even if you do not have a written statement of need or a confidentiality agreement from the physician or nurse who is handling the medical emergency.

You may require a written statement of need and confidentiality agreement, in accordance with the provisions of nonemergency situations and confidentiality agreement of this rule (see WAC 296-62-05315), as soon as the circumstances of the medical emergency permit.
[Statutory Authority: RCW 47.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-05315, filed 05/09/01, effective 09/01/01.

WAC 296-62-05315 Reveal trade secret information in nonemergency situations when requested by a health professional, employee, or designated representative.

The request by the health professional, employee, or designated representative must:

- Be in writing.
- Describe with reasonable detail one or more of the reasons the information is needed. The reason(s) must be related to occupational health needs, such as to:
  - ♦ Assess the hazards of the chemicals to which employees will be exposed.
  - ♦ Conduct or assess sampling of the workplace atmosphere to determine employee exposure levels.
  - ♦ Conduct preassignment or periodic medical surveillance of exposed employees.
  - ♦ Provide medical treatment to exposed employees.
  - ♦ Select or assess appropriate personal protective equipment for exposed employees.
  - ♦ Design or assess engineering controls or other protective measures for exposed employees.
  - ♦ Conduct studies to determine the health effects of exposure.
  - ♦ Explain in detail why the disclosure of the specific chemical identity is essential.
- Explain why disclosing the:
  - ♦ Properties and effects of the chemical.
  - ♦ Measures for controlling workers' exposure to the chemical.
  - ♦ Methods of monitoring and analyzing worker exposure to the chemical.
  - ♦ Methods of diagnosing and treating harmful exposures to the chemical in lieu of trade secret information would prevent the health professional, employee, or designated representative from providing the occupational health services described in the occupational health needs description.
- Describe procedures to be used to maintain the confidentiality of the disclosed information. The health professional, employee, or designated representative and the employer or contractor of the services of the health professional or designated representative agree in a written confidentiality agreement that the health professional, employee, or designated representative:
  - ♦ Will not use the trade secret information for any purpose other than the health need(s) described; and
  - ♦ Agree not to release the information under any circumstances other than to WISHA, except as authorized by the terms of the agreement or by the employer.

This confidentiality agreement may:

- Restrict the use of the information to the health purposes indicated in the written statement of need.
- Provide for appropriate legal remedies in the event of a breach of the agreement, including a reasonable preestimate of likely damages.
- Not include requirements for the posting of a penalty bond.

If the health professional, employee, or designated representative receiving the trade secret information decides that there is a need to disclose it to WISHA, he or she must inform the employer who provided the information prior to, or at the same time as disclosing it to WISHA.

Nothing in this section is meant to preclude the parties from pursuing noncontractural remedies to the extent permitted by law.

[Statutory Authority: RCW 47.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-05315, filed 05/09/01, effective 09/01/01.

WAC 296-62-05320 Deny a written request for disclosure of a specific chemical identity in the manner specified in this rule.

If you choose to deny a written request for disclosure of information about a specific chemical identity, your denial must:

- Be given to the health professional, employee, or designated representative within thirty days of the request.
- Be in writing.
- Include evidence to support the claim that the specific chemical identity is a trade secret.
- State the specific reasons why the request is being denied.
- Explain in detail how alternative information may satisfy the specific medical or occupational health need without revealing the specific chemical identity.
- If a request for information is denied under the nonemergency section of this rule, the request may then be referred with the written denial of the request to WISHA for consideration.
- When a denial is referred to WISHA, WISHA must consider the evidence to determine if the:

    - Chemical manufacturer, importer or employer has supported the claim that the specific chemical identity is a trade secret.
    - Health professional, employee, or designated representative has supported the claim that there is a medical or occupational health need for the information.
    - Health professional, employee, or designated representative has demonstrated adequate means to protect the confidentiality of the trade secret information.

Potential outcomes of denying a written request for trade secret information:

- If WISHA determines that the specific chemical identity requested under the nonemergency situations section is not a bona fide trade secret, or that it is a trade secret but the requesting health professional, employee, or designated representative has a legitimate medical or occupational health need for the information, has executed a written confidentiality agreement, and has shown adequate means for complying with the terms of such agreement, the chemical manufacturer, importer or employer will be subject to citation by WISHA.
- If a chemical manufacturer, importer or employer demonstrates to WISHA that the execution of a confidentiality agreement would not provide sufficient protection against potential harm from the unauthorized disclosure of a trade secret specific chemical identity, the director may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested chemical information as may be appropriate to assure that the occupational health needs are met without an undue risk of harm to the chemical manufacturer, importer or employer.
- In spite of the existence of a trade secret claim, a chemical manufacturer, importer or employer must upon request, disclose to the director or his representative, any information that this section requires the chemical manufacturer, importer or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the director so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

[Statutory Authority: RCW 47.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-05320, filed 05/09/01, effective 09/01/01.

WAC 296-62-05325 Understand what is a trade secret. The following is a reprint of the *Restatement of Torts* section 757, comment b (1939):

b. **Definition of trade secret.** A trade secret may consist of any formula, pattern, device or compilation of information which is used on one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula for a chemical compound, a process of manufacturing, treating or preserving materials, a pattern for a machine or other device, or a list of customers. It differs from other secret information in a business (see § 759 of the *Restatement of Torts* which is not included in this Appendix) in that it is not simply information as to single or ephemeral events in the conduct of the business, as, for

WAC 296-62-05235 (Cont.)

example, the amount of other terms of a secret bid for a contract or the salary of certain employees, or the security investments made or contemplated, or the date fixed for the announcement of a new policy or for bringing out a new model or the like. A trade secret is a process or device for continuous use in the operations of the business. Generally it relates to the production of goods, as, for example, a machine or formula for the production of an article. It may, however, relate to the sale of goods or to other operations in the business, such as a code for determining discounts, rebates or other concessions in a price list or catalogue, or a list of specialized customers, or a method of bookkeeping or other office management.

Secrecy. The subject matter of a trade secret must be secret. Matters of public knowledge or of general knowledge in an industry cannot be appropriated by one as his secret. Matters which are completely disclosed by the goods which one markets cannot be his secret. Substantially, a trade secret is known only in the particular business in which it is used. It is not requisite that only the proprietor of the business know it. He may, without losing his protection, communicate it to employees involved in its use. He may likewise communicate it to others pledged to secrecy. Others may also know of it independently, as, for example, when they have discovered the process or formula by independent invention and are keeping it secret. Nevertheless, a substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring the information. An exact definition of a trade secret is not possible. Some factors to be considered in determining whether given information is one's trade secret are:

(1) The extent to which the information is known outside of his business;
(2) The extent to which it is known by employees and others involved in his business;
(3) The extent of measures taken by him to guard the secrecy of the information;
(4) The value of the information to him and his competitors;
(5) The amount of effort or money expended by him in developing the information;
(6) The ease or difficulty with which the information could be properly acquired or duplicated by others.

Novelty and prior art. A trade secret may be a device or process which is patentable; but it need not be that. It may be a device or process which is clearly anticipated in the prior art or one which is merely a mechanical improvement that a good mechanic can make. Novelty and invention are not requisite for a trade secret as they are for patentability. These requirements are essential to patentability because a patent protects against unlicensed use of the patented device or process even by one who discovers it properly through independent research. The patent monopoly is a reward to the inventor. But such is not the case with a trade secret. Its protection is not based on a policy of rewarding or otherwise encouraging the development of secret processes or devices. The protection is merely against breach of faith and reprehensible means of learning another's secret. For this limited protection it is not appropriate to require also the kind of novelty and invention which is a requisite of patentability. The nature of the secret is, however, an important factor in determining the kind of relief that is appropriate against one who is subject to the liability under the rule stated in this section. Thus, if the secret consists of a device or process which is a novel invention, one who acquires the secret wrongfully is ordinarily enjoined from further use of it and is required to account for the profits derived from his past use. If, on the other hand, the secret consists of mechanical improvements that a good mechanic can make without resort to the secret, the wrongdoer's liability may be limited to damages, and an injunction against future use of the improvements made with the aid of the secret may be inappropriate.

[Statutory Authority: RCW 47.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-05325, filed 05/09/01, effective 09/01/01.

PART C
HAZARD COMMUNICATION

WAC

WAC 296-62-054 Manufacturers, importers and distributors--Hazard communication. Your responsibility: To ensure that the hazards of all chemicals produced or imported are evaluated and that information concerning their hazards is given to employers and employees.

Note: If you have employees exposed to the chemicals you produce, import or distribute, you must comply with "Chemical hazard communication rule" WAC 296-800-170.

Note: If you are an employer who relies on a material safety data sheet from the manufacturer, importer or distributor and you distribute or produce hazardous chemicals, you do not have to comply with this rule.

You must:

- Determine whether the chemicals you produce in your workplace or import are hazardous. *WAC 296-62-05402*.
- Use this criteria in making hazard determinations. *WAC 296-62-05404*.
- Determine whether the chemicals you produce or import are health hazards. *WAC 296-62-05406.*
- Obtain or develop a material safety data sheet for each hazardous chemical you produce or import. W*AC 296-62-05408.*
- Label clearly each container of hazardous chemicals that leaves your workplace. *WAC 296-62-05410.*
- Provide material safety data sheets. *WAC 296-62-05412.*

Application of this standard:

The Manufacturers, Importers, and Distributors Hazardous Communication Rule DOES NOT APPLY TO:

- Any hazardous waste as such term is defined by the Hazardous Waste Management Act chapter 70.105 RCW, when subject to regulations issued under that act by the department of ecology that describes specific safety, labeling, personnel training and other standards for the accumulation, handling and management of hazardous waste;
- Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et seq.), when subject to regulations issued under that act by the Environmental Protection Agency;
- Any hazardous substance as such term is defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C.9601 et seq.), when the hazardous substance is the focus of remedial or removal action being conducted under CERCLA in accordance with Environmental Protection Agency regulations;
- Tobacco or tobacco products;
- Wood or wood products, including lumber that will not be processed, where the chemical manufacturer or importer can establish that the only hazard they pose to the employees is the potential for flammability or combustibility (wood or wood products that have been treated with hazardous chemicals covered by this standard, and wood that may be subsequently sawed or cut, generating dust, are not exempted);

WAC 296-62-054 (Cont.)

- Articles are manufactured items other than a fluid or particle:
  - That are formed to a specific shape or design during manufacture;
  - That have end use function(s) dependent in whole or in part upon their shape or design during end use; and
  - That under normal conditions of use do not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under the hazard determination section of this rule), and do not pose a physical hazard or health risk to employees.
- Food or alcoholic beverages that are sold, used, or prepared in a retail establishment (such as grocery store, restaurant, or drinking place), and foods intended for personal consumption by employees while in the workplace;
- Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), when it is in solid, final form for direct administration to the patient (e.g., tablets or pills); drugs that are packaged by the chemical manufacturer for sale to consumers in a retail establishment (e.g., over-the-counter drugs); and drugs intended for personal consumption by employees while in the workplace (e.g., first aid supplies);
- Cosmetics that are packaged for sale to consumers in a retail establishment, and cosmetics intended for personal consumption by employees while in the workplace;
- Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substance Act (15 U.S.C. 1261 et seq.) respectively, where the employer can show that it is used in the workplace for the purpose intended by the chemical manufacturer or importer of the product, and the use results in a duration and frequency of exposure that is not greater than the range of exposures that could reasonably be experienced by consumers when used for the purpose intended;
- Ionizing and nonionizing radiation; and
- Biological hazards.

[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-054, filed 05/09/01, effective 09/01/01.

WAC 296-62-05402 Determine whether the chemicals you produce in your workplace or import are hazardous. Chemical manufacturers and importers must evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous.

Chemical manufacturers, importers or employers evaluating chemicals must identify and consider the available scientific evidence concerning physical and health hazards. For health hazards, evidence that is statistically significant and that is based on at least one positive study conducted in accordance with established scientific principles is considered to be sufficient to establish a hazardous effect if the results of the study meet the definitions of health hazards in this part. WAC 296-62-05406 must be consulted for the scope of health hazards covered, and WAC 296-62-05404 must be consulted for the criteria to be followed with respect to the completeness of the evaluation, and the data to be reported.

The chemical manufacturer, importer or employer evaluating chemicals must treat the following sources as establishing that the chemicals listed in them are hazardous:

- Chapter 296-62 WAC, General occupational health standards;
- 29 C.F.R. Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA); or
- *Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment*, American Conference of Governmental Industrial Hygienists (ACGIH) (latest edition).
- The chemical manufacturer, importer or employer is responsible for evaluating the hazards associated with the chemicals in these source lists in accordance with this requirement of the standard.

Chemical manufacturers, importers and employers evaluating chemicals must treat the following sources as establishing that a chemical is a carcinogen or potential carcinogen for hazard communication purposes:

WAC 296-62-05402 (Cont.)

- National Toxicology Program (NTP), Annual Report on Carcinogens (latest edition);
- International Agency for Research on Cancer (IARC) Monographs (latest editions);
- Chapter 296-62 WAC, General occupational health standards; or
- 29 C.F.R. Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration.

Note: The Registry of Toxic Effects of Chemical Substances published by the National Institute for Occupational Safety and Health indicates whether a chemical has been found by the NTP or IARC to be a potential carcinogen.

The chemical manufacturer, importer or employer must determine the hazards of mixtures of chemicals as follows:

- If a mixture has been tested as a whole to determine its hazards, the results of such testing must be used to determine whether the mixture is hazardous;
- If a mixture has not been tested as a whole to determine whether the mixture is a health hazard, the mixture must be assumed to present the same health hazards as do the components that comprise one percent (by weight or volume) or greater of the mixture, except that the mixture must be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater that is considered to be a carcinogen;
- If a mixture has not been tested as a whole to determine whether the mixture is a physical hazard, the chemical manufacturer, importer, or employer may use whatever scientifically valid data is available to evaluate the physical hazard potential of the mixture; and
- If the chemical manufacturer, importer, or employer has evidence to indicate that a component present in the mixture in concentrations of less than one percent (or in the case of carcinogens, less that 0.1 percent) could be released in concentrations that would exceed and established WISHA or OSHA permissible exposure limit or ACGIH threshold limit value, or could present a health risk to employees in those concentrations, the mixture must be assumed to present the same hazard.

Chemical manufacturers, importers, or employers evaluating chemicals must describe in writing the procedures they use to determine the hazards of the chemical they evaluate. The written procedures are to be made available, upon request, to employees, their designated representatives, the director or his/her designee and the National Institute of Occupational Safety and Health (NIOSH). The written description may be incorporated into the written hazard communication program required under WAC 296-800-17005.
[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-05402, filed 05/09/01, effective 09/01/01.

WAC 296-62-05404 Use these criteria in making hazard determinations. The hazard determination requirements of this standard is performance-oriented. Chemical manufacturers, importers, and employers evaluating chemicals are not required to follow any specific methods for determining hazards, but they must be able to demonstrate that they have adequately ascertained the hazards of the chemicals produced or imported in accordance with the criteria set forth in this rule.

Hazard evaluation is a process that relies heavily on the professional judgment of the evaluator, particularly in the area of chronic hazards. The performance-orientation of the hazard determination does not diminish the duty of the chemical manufacturer, importer or employer to conduct a thorough evaluation, examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this rule:

- Carcinogenicity: A determination by the National Toxicology Program, the International Agency for Research on Cancer, WISHA or OSHA that a chemical is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this part. In addition, however, all available scientific data on carcinogenicity must be evaluated in accordance with the provisions of the requirements of this rule.

- Human data: Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

WAC 296-62-05404 (Cont.)

- Animal data: Human evidence of health effects in exposed populations is generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results.
- Adequacy and reporting of data: The results of any studies that are designed and conducted according to established scientific principles, and that report statistically significant conclusions regarding the health effects of a chemical, shall be a sufficient basis for a hazard determination and reported on any material safety data sheet. In vitro studies alone generally do not form the basis for a definitive finding of a hazard under the hazard communication standard since they have a positive or negative result rather than a statistically significant finding.

The chemical manufacturer, importer, or employer may also report the results of other scientifically valid studies that tend to refute the findings of hazard.
[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-05404, filed 05/09/01, effective 09/01/01.

WAC 296-62-05406 Determine whether the chemicals you produce or import are health hazards.

Although safety hazards related to the physical characteristics of a chemical can be objectively defined in terms of testing requirements (e.g., flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body -- such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees -- such as shortness of breath, a nonmeasurable, subjective feeling. Employees exposed to such hazards must be apprised of both the changes in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in nonoccupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large, such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most chemicals have not been adequately tested to determine their health hazard potential, and data do not exist to substantiate these effects.

There have been many attempts to categorize effects and to define them in various ways. Generally, the terms “acute” and “chronic” are used to delineate between effects on the basis of severity or duration. “Acute” effects usually occur rapidly as a result of short-term exposures, and are of short duration. “Chronic” effects generally occur as a result of long-term exposure, and are of long duration.

The acute effects referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1-1988) -- irritation, corrosivity, sensitization and lethal dose. Although these are important health effects, they do not adequately cover the considerable range of acute effects that may occur as a result of occupational exposure, such as, for example, narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are obviously a concern in the workplace, but again, do not adequately cover the area of chronic effects, excluding, for example, blood dyscrasias (such as anemia), chronic bronchitis and liver atrophy.

The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them.

WAC 296-62-05404 outlines the principles and procedures of hazard assessment.

WAC 296-62-05406 (Cont.)

For the purposes of this part, any chemicals that meet any of the following definitions, as determined by the criteria set forth in WAC 296-62-05404, are health hazards. However, this is not intended to be an exclusive categorization scheme. If there are available scientific data that involve other animal species or test methods, they must also be evaluated to determine the applicability of the hazard communication rule:

- **Carcinogen:** A chemical is considered to be a carcinogen if:
  - If it has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or
  - It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
  - It is regulated by WISHA as a carcinogen.
- **Corrosive:** A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 C.F.R. Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term must not refer to action on inanimate surfaces.
- **Highly Toxic:** A chemical falling within any of the following categories:
  - A chemical that has a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
  - A chemical that has a median lethal dose (LD_{50}) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
  - A chemical that has a median lethal concentration of (LC_{50}) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.
- **Irritant:** A chemical, which is not corrosive, but that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 C.F.R. 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 C.F.R. 1500.42 or other appropriate techniques.
- **Sensitizer:** A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.
- **Toxic:** A chemical falling within any of the following categories:
  - A chemical that has a median lethal dose (LD_{50}) of more than 50 milligrams per kilogram but note more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
  - A chemical that has a median lethal dose (LD_{50}) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.
  - A chemical that has a median lethal concentration (LC_{50}) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

WAC 296-62-05406 (Cont.)

- **Target organ effects:** The following is a target organ categorization of effects that may occur, including examples of signs and symptoms and chemicals that have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive:

(a)	Hepatotoxins:	Chemicals that produce liver damage.
	Signs & symptoms:	Jaundice, liver enlargement.
	Chemicals:	Carbon tetrachloride, nitrosamines.
(b)	Nephrotoxins:	Chemicals that produce kidney damage.
	Signs & symptoms:	Edema; proteinuria.
	Chemicals:	Halogenated hydrocarbons; uranium.
(c)	Neurotoxins:	Chemicals that produce their primary toxic effects on the nervous system.
	Signs & symptoms:	Narcosis; behavioral changes; decrease in motor functions.
	Chemicals:	Mercury, carbon disulfide.
(d)	Agents that act on the blood or hematopoietic system:	Decrease hemoglobin function; deprive the body of oxygen.
	Signs & symptoms:	Cyanosis; loss of consciousness.
	Chemicals:	Carbon monoxide; cyanides.
(e)	Agents that damage the lung:	Chemicals that irritate or damage the pulmonary tissue.
	Signs & symptoms:	Cough; tightness in chest; shortness of breath.
	Chemicals:	Silica, asbestos.
(f)	Reproductive toxins:	Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).
	Signs & symptoms:	Birth defects; sterility.
	Chemicals:	Lead; DBCP.
(g)	Cutaneous hazards:	Chemicals that affect the dermal layer of the body.
	Signs & symptoms:	Defatting of the skin; rashes; irritation.
	Chemicals:	Ketones; chlorinated compounds.
(h)	Eye hazards:	Chemicals that affect the eye or visual capacity.
	Signs & symptoms	Conjunctivitis; corneal damage.
	Chemicals:	Organic solvents; acids.

[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-05406, filed 05/09/01, effective 09/01/01.

WAC 296-62-05408 Obtain or develop a material safety data sheet for each hazardous chemical you produce or import. Chemical manufacturers and importers must obtain or develop a material safety data sheet (MSDS) for each hazardous chemical they produce or import.

Each material safety data sheet must be in English (although the employer may maintain copies in other languages) and must contain at least the following information:

- The identity used on the label, and, except as provided for in the trade secrets rule, WAC 296-62-053:

WAC 296-62-05408 (Cont.)

- ♦ If the hazardous chemical is a single substance, its chemical and common name(s);
- ♦ If the hazardous chemical is a mixture that has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients that contribute to these known hazards, and the common name(s) of the mixture itself; or
- ♦ If the hazardous chemical is a mixture that has not been tested as a whole:
  - (A) The chemical and common name(s) of all ingredients that have been determined to be health hazards, and that comprise 1% or greater of the composition, except that chemicals identified as carcinogens under "*Determine whether the chemicals you produce in your workplace or import are hazardous*" section in "Manufactures, importers and distributors, chemical hazard communication ," WAC 296-62-05401, shall be listed if the concentrations are 0.1% or greater; and
  - (B) The chemical and common name(s) of all ingredients that have been determined to be health hazards, and that comprise less than one percent (0.1% for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations that would exceed and established WISHA or OSHA permissible exposure limit or ACGIH threshold limit value, or could present a health risk to employees; and
  - (C) The chemical and common name(s) of all ingredients that have been determined to present a physical hazard when present in the mixture.

- Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);
- The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity;
- The acute and chronic health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions that are generally recognized as being aggravated by exposure to the chemical;
- The primary route(s) of entry;
- The WISHA or OSHA permissible exposure limit, ACGIH threshold limit value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the material safety data sheet (the PELs and TLVs include the 8-hour TWA, STEL, ceiling value and skin notation where available);
- Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions), or by WISHA or OSHA;
- Any generally applicable precautions for safe handling and use that are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks;
- Any generally applicable control measures that are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, such as appropriate engineering controls, work practices, or personal protective equipment;
- Emergency and first aid procedures;
- The date of preparation of the material safety data sheet or the last change to it; and
- The name, address and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the material safety data sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

If no relevant information is found for any given category on the material safety data sheet, the chemical manufacturer, importer or employer preparing the material safety data sheet must mark it to indicate that no applicable information was found.

WAC 296-62-05408 (Cont.)

Where complex mixtures have similar hazards and contents (i.e., the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer or employer may prepare one material safety data sheet to apply to all of these similar mixtures.

The chemical manufacturer, importer or employer preparing the material safety data sheet must ensure that the information recorded accurately reflects the scientific evidence used in making the hazard determination. If the chemical manufacturer, importer or employer preparing the material safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information must be added to the material safety data sheet within three months. If the chemical is not currently being produced or imported, the chemical manufacturer or importer must add the information to the material safety data sheet before the chemical is introduced into the workplace again.
[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-05408, filed 05/09/01, effective 09/01/01.

WAC 296-62-05410 Label clearly each container of hazardous chemicals that leaves your workplace. The chemical manufacturer, importer, or distributor must ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged or marked with the following information:

- Identity of the hazardous chemical(s);
- Appropriate hazard warnings; and
- Name and address of the chemical manufacturer, importer, or other responsible party.

For solid metal (such as a steel beam or metal casting), solid wood, or plastic items that are not exempted as articles due to their downstream use, or shipments of whole grain, the required labels may be:

- Transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes;
- Transmitted with the initial shipment itself, or with the material safety data sheet that is to be provided to or at the time of the first shipment; and
- This exception to requiring labels on every container of hazardous chemicals is only for the solid material itself and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the material and to that which employees handling the items in transit may be exposed (for example, cutting fluids or pesticides in grain).

Chemical manufacturers, importers, or distributors must ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked in accordance with this part in a manner that does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and regulations issued under that act by the department of transportation.

If the hazardous chemical is regulated by WISHA or OSHA in a substance-specific health standard, the chemical manufacturer, importer, distributor or employer must ensure that the labels or other forms of warning used are in accordance with the requirements of that standard.

The chemical manufacturer, importer, distributor or employer need not affix new labels to comply with this part if existing labels already convey the required information.

Chemical manufacturers, importers, distributors, or employers who become newly aware of any significant information regarding the hazards of a chemical must revise the labels for the chemical within three months of becoming aware of the new information. Labels on containers of hazardous chemicals shipped after that time must contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importer, distributor, or employer must add the information to the label before the chemical is shipped or introduced into the workplace again.

WAC 296-62-05410 (Cont.)

Retention of DOT markings, placards and labels:

- Any employer who receives a package of hazardous material that is required to be marked, labeled or placarded in accordance with the U.S. Department of Transportation's Hazardous Materials Regulations (49 C.F.R. Parts 171 through 180) must retain those markings, labels and placards on the package until the packaging is sufficiently cleaned of residue and purged of vapors to remove any potential hazards.
- Any employer who receives a freight container, rail freight car, motor vehicle, or transport vehicle that is required to be marked or placarded in accordance with the Hazardous Materials Regulations must retain those markings and placards on the freight container, rail freight car, motor vehicle or transport vehicle until the hazardous materials that require the marking or placarding are sufficiently removed to prevent any potential hazards.
- Markings, placards and labels must be maintained in a manner that ensures that they are readily visible.
- For nonbulk packages that will not be reshipped, the provisions of this section are met if a label or other acceptable marking is affixed in accordance with this rule.
- For the purposes of this section, the term "**hazardous material"** and any other terms not defined in this section have the same definition as in the Hazardous Materials Regulations (49 C.F.R. Parts 171 through 180).

The hazard communication rule does not require labeling of the following chemicals:

- Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 et seq.), when subject to the labeling requirements of that act and labeling regulations issued under that act by the Environmental Protection Agency;
- Any chemical substance or mixture as such terms are defined in the Toxic Substance Control Act (15 U.S.C. 2601 et seq.), when subject to the labeling requirements of that act and labeling requirements issued under that act by the Environmental Protection Agency;
- Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device or product, including materials intended for use as ingredients in such products (e.g., flavors and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) or the Virus-Serum Toxin Act of 1913 (21 U.S.C. 151 et seq.) and regulations issued under those acts, when they are subject to the labeling requirements under those acts by either the Food and Drug Administration or the department of agriculture;
- Any distilled spirits (beverage alcohols), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 et seq.) and regulations issued under that act, when subject to the labeling requirements of that act and labeling regulations issued under that act by the Bureau of Alcohol, Tobacco, and Firearms;
- Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substance Act (15 U.S.C. 1261 et seq.) respectively, when subject to a consumer product safety standard or labeling requirement of those acts, or regulations issued under those acts by the Consumer Product Safety Commission; and
- Agricultural or vegetable seed treated with pesticides and labeled in accordance with the Federal Seed Act (7 U.S.C. 1551 et seq.) and the labeling requirements issued under that act by the department of agriculture.

[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-05410, filed 05/09/01, effective 09/01/01.

WAC 296-62-05412 Provide material safety data sheets. Chemical manufacturers or importers must:

- Ensure that distributors and employers are provided an appropriate material safety data sheet with their initial shipment, and with the first shipment after a material safety data sheet is updated;
- Either provide material safety data sheets with the shipped containers or send them to the distributor or employer prior to or at the time of the shipment;

WAC 296-62-05412 (Cont.)

- If the material safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the distributor or employer must obtain one from the chemical manufacturer or importer as soon as possible; and
- Also, provide distributors or employers with a material safety data sheet upon request.

Distributors must:

- Ensure that material safety data sheets, and updated information, are provided to other distributors and employers with their initial shipment and with the first shipment after a material safety data sheet is updated;
- Either provide material safety data sheets with the shipped containers, or sent them to the other distributor or employer prior to or at the time of the shipment;
- If the material safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the distributor must obtain one from the chemical manufacturer or importer as soon as possible.

Retailers selling hazardous chemicals to employers having a commercial account must provide a material safety data sheet to such employers upon request, and must post a sign or otherwise inform them that a material safety data sheet is available.

Wholesale distributors selling hazardous chemicals to employers over-the-counter may also provide material safety data sheets upon request of the employer at the time of the over-the-counter purchase, and must post a sign or otherwise inform such employers that a material safety data sheet is available.

If an employer without a commercial account purchases a hazardous chemical from a retail distributor not required to have material safety data sheets on file (i.e., the retail distributor does not have a commercial account and does not use the materials), the retail distributor must provide the employer, upon request, with the name, address, and telephone number of the chemical manufacturer, importer, or distributor from which a material safety data sheet can be obtained.

Wholesale distributors must also provide material safety data sheets to employers or other distributors upon request.

Chemical manufacturers, importers, and distributors need not provide material safety data sheets to retail distributors that have informed them that the retail distributor does not sell the product to commercial accounts or open the sealed container to use it in their own workplaces.

[Statutory Authority: RCW 49.17.101, .040, .050. 01-11-038 (Order 99-36), § 296-62-05412, filed 05/09/01, effective 09/01/01.

PART D
CONTROLS AND DEFINITIONS

WAC

WAC 296-62-060 Control requirements in addition to those specified.

(1) In those cases where no acceptable standards have been derived for the control of hazardous conditions, every reasonable precaution shall be taken to safeguard the health of the worker whether provided herein or not.

(2) **Preservation of records.**

(a) Scope and application. This section applies to each employer who makes, maintains or has access to employee exposure records or employee medical records.

(b) Definitions.

(i) **"Employee exposure record"** - a record of monitoring or measuring which contains qualitative or quantitative information indicative of employee exposure to toxic materials or harmful physical agents. This includes both individual exposure records and general research or statistical studies based on information collected from exposure records.

(ii) **"Employee medical record"** - a record which contains information concerning the health status of an employee or employees exposed or potentially exposed to toxic materials or harmful physical agents. These records may include, but are not limited to:

(A) The results of medical examinations and tests;

(B) Any opinions or recommendations of a physician or other health professional concerning the health of an employee or employees; and

(C) Any employee medical complaints relating to workplace exposure. Employee medical records include both individual medical records and general research or statistical studies based on information collected from medical records.

(c) Preservation of records. Each employer who makes, maintains, or has access to employee exposure records or employee medical records shall preserve these records.

(d) Availability of records. The employer shall make available, upon request, to the director, department of labor and industries, or his designee, all employee exposure records and employee medical records for examination and copying.

(e) Effective date. This standard shall become effective thirty days after filing with the code reviser.

(3) **Monitoring of employees.** The department shall use industrial hygiene sampling methods and techniques including but not limited to personal monitoring devices and equipment approved by the director or his designee for the purpose of establishing compliance with chapter 296-62 WAC.

WAC 296-62-060 (Cont.)

(a) The employer shall permit the director or his designee to monitor and evaluate any workplace or employee in accordance with all provisions of this subsection.

(b) The employer shall not prevent or discourage an employee from cooperating with the department by restricting or inhibiting his/her participation in the use of personal monitoring devices and equipment in accordance with all provisions of this subsection.

[Statutory Authority: RCW 49.17.040, 49.17.050, and 49.17.240. 80-11-010 (Order 80-14), § 296-62-060, filed 8/8/80; Order 73-3, § 296-62-060, filed 5/7/73; Order 70-8, § 296-62-060, filed 7/31/70, effective 9/1/70; Rule 6.010, effective 8/1/63.]

WAC 296-62-070 Chemical agents (airborne or contact).

[Order 70-8, § 296-62-070, filed 7/31/70, effective 9/1/70; Section VII, effective 8/1/63.]

WAC 296-62-07001 Definitions (airborne chemical agents).

(1) **"Dust"** means solid particles suspended in air, generated by handling, drilling, crushing, grinding, rapid impact, detonation, or decrepitation of organic or inorganic materials such as rock, ore, metal, coal, wood, grain, etc.

(2) **"Fume"** means solid particles suspended in air, generated by condensation from the gaseous state, generally after volatilization from molten metals, etc., and often accompanied by a chemical reaction such as oxidation.

(3) **"Gas"** means a normally formless fluid which can be changed to the liquid or solid state by the effect of increased pressure or decreased temperature or both.

(4) **"Mist"** means liquid droplets suspended in air, generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state, such as by splashing, foaming or atomizing.

(5) **"Vapor"** means the gaseous form of a substance which is normally in the solid or liquid state.

[Order 73-3, § 296-62-07001, filed 5/7/73.]

WAC 296-62-07003 Definitions (contact chemical agents).

(1) **"Corrosives"** means substances which in contact with living tissue cause destruction of the tissue by chemical action.

(2) **"Irritants"** means substances which on immediate, prolonged, or repeated contact with normal living tissue will induce a local inflammatory reaction.

(3) **"Toxicants"** means substances which have the inherent capacity to produce personal injury or illness to man by absorption through any body surface.

[Order 73-3, § 296-62-07003, filed 5/7/73.]

WAC 296-62-07005 Control of chemical agents. Chemical agents shall be controlled in such a manner that they will not constitute a hazard to the worker, or workers shall be protected from the hazard of contact with or exposure to chemical agents.

[Order 73-3, § 296-62-07005, filed 5/7/73.]

Part E

Respiratory Protection

WAC 296-62-071 Respiratory protection.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-071, filed 05/04/99, effective 09/01/99. [Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-071, filed 7/27/81.]

WAC 296-62-07101 To whom does chapter 296-62 WAC, Part E apply? Chapter 296-62 WAC, Part E applies to all employers covered by WISHA. Other requirements for personal protective equipment (PPE) are found in WAC 296-800-160.
[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07101, filed 05/09/01, effective 09/09/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07101, filed 05/04/99, effective 09/01/99. [Statutory Authority: RCW 49.17.040 and 49.17.050. 82-08-026 (Order 82-10), § 296-62-07101, filed 3/30/82. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07101, filed 7/27/81.]

Permissible Practice

WAC 296-62-07102 When are you allowed to rely on respirators to protect employees from breathing contaminated air? In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, vapors, or aerosols the goal must be to prevent atmospheric contamination. You must use, if feasible, accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, you must use respirators as required by chapter 296-62 WAC, Part E.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07102, filed 05/04/99, effective 09/01/99.]

Employer Responsibilities

WAC 296-62-07103 What are your responsibilities as an employer?

(1) You must provide respirators, when necessary, to protect the health of your employees against recognized respiratory hazards including any exposures in excess of the permissible exposure limit.

(2) You must provide NIOSH-certified respirators that are applicable and suitable for the purpose intended.

(3) You must make sure your employees use respirators when required or when otherwise necessary.

(4) You must establish and maintain a written respiratory protection program that includes the requirements outlined in WAC 296-62-07111.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07103, filed 05/04/99, effective 09/01/99.
[Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07103, filed 7/27/81.]

Definitions

WAC 296-62-07105 Definitions. The following definitions are important terms used in this part.

Aerosol means a suspension of liquid or solid particles in air.

Air-purifying respirator means a respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

Assigned protection factor (APF) is the expected level of workplace respiratory protection provided by a properly functioning respirator worn by properly fitted and trained individuals. It describes the ratio of the ambient concentration of an airborne substance to the concentration of the substance inside the respirator.

Atmosphere-supplying respirator means a respirator that supplies the respirator user with breathing air from an uncontaminated source, and includes supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA)

units.

Canister or cartridge (air-purifying) means a container with a filter, sorbent, or catalyst, or any combination of these materials, which removes specific contaminants from the air drawn through it.

Canister (oxygen-generating) means a container filled with a chemical that generates oxygen by chemical reaction.

Demand respirator means an atmosphere-supplying respirator that admits breathing air to the facepiece only when suction is created inside the facepiece by inhalation.

Dust means a solid, mechanically-produced particle with sizes varying from submicroscopic to visible. See WAC 296-62-07001(1).

Dusk Mask means a type of filtering facepiece respirator. See the definition for "filtering facepiece."

Emergency situation means any occurrence that may or does result in an uncontrolled significant release of an airborne contaminant. Causes of emergency situations include, but are not limited to, equipment failure, rupture of containers, or failure of control equipment.

Employee exposure means exposure to a concentration of an airborne contaminant that would occur if the employee were not using respiratory protection.

End-of-service-life indicator (ESLI) means a system that warns the respirator user of the approach of the end of adequate respiratory protection: For example, that the sorbent is approaching saturation or is no longer effective.

Escape-only respirator means a respirator intended to be used only for emergency exit.

Filter or air-purifying element means a component used in respirators to remove solid or liquid aerosols from the air when it is breathed.

Filtering facepiece (dust mask) means a tight-fitting, half-face, negative pressure, particulate respirator having a facepiece entirely or completely composed of filter material without attached cartridges or canisters.

Fit factor means a quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio between the measured concentration of a substance in ambient air to its concentration inside the respirator when worn.

Fit test means the use of an accepted protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual (see also Qualitative fit test QLFT and Quantitative fit test QNFT).

Fog means a mist of sufficient concentration to perceptibly obscure vision.

Full facepiece means a respirator that covers the wearer's nose, mouth, and eyes.

Fume means a solid condensation particle of extremely small particle size, generally less than one micrometer in diameter. See WAC 296-62-07001(2).

Half facepiece means a respirator that covers the wearer's nose and mouth.

Helmet means the rigid portion of a respirator that also provides protection against impact or penetration.

High-efficiency particulate air filter (HEPA) means a filter that removes from air 99.97% or more of monodisperse dioctyl phthalate (DOP) particles having a mean particle diameter of 0.3 micrometer.

Hood means the portion of a respirator that completely covers the head and neck, may also cover portions of the shoulders and torso.

Immediately dangerous to life or health (IDLH) means an atmosphere that poses an threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

Loose-fitting facepiece means a respiratory inlet covering that is designed to form a partial seal with the face.

Mist means a liquid condensation particle with sizes ranging from submicroscopic to visible. See WAC 296-62-07001(4).

Negative pressure respirator means a tight-fitting respirator in which the air pressure inside the facepiece is lower than the ambient air pressure outside the respirator during inhalation.

Nonroutine respirator use means wearing a respirator when carrying out a special task that occurs infrequently.

Odor threshold limit means the lowest concentration of a contaminant in air that can be detected by smell.

Oxygen deficient atmosphere means an atmosphere with an oxygen content below 19.5% by volume.

Particulate means a solid or liquid aerosol such as dust, fog, fume, mist, smoke, or spray.

Permissible exposure limit (PEL) means the legally established time-weighted average (TWA) concentration or ceiling concentration of a contaminant that must not be exceeded.

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (for example, license, registration, or certification) allows him or her to independently provide, or be delegated the responsibility to provide, some or all of the health care services required in WAC 296-62-07150 through 296-62-07156.

Positive-pressure respirator means a respirator in which the air pressure inside the respiratory-inlet covering exceeds the ambient air pressure outside the respirator.

Powered air-purifying respirator (PAPR) means an air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

Pressure demand respirator means a positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation or leakage.

Qualitative fit test (QLFT) means a pass/fail fit test that relies on the individual's response to the test agent to assess the adequacy of respirator fit for an individual.

Quantitative fit test (QNFT) means an assessment of the adequacy of respirator fit for an individual by numerically measuring the amount of leakage into the respirator.

Respirable means air that is suitable for breathing.

Respirator means a device, which may or may not be certified by NIOSH, designed to protect the wearer from breathing harmful atmospheres.

WAC 296-62-07105 (Cont.)

Respiratory-inlet covering means that portion of a respirator that forms the protective barrier between the user's respiratory tract and an air-purifying device or breathing air source, or both. It may be a facepiece, helmet, hood, suit, or mouthpiece respirator with nose clamp.

Self-contained breathing apparatus (SCBA) means an atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

Service life means the period of time that a respirator, filter or sorbent, or other respiratory equipment provides adequate protection to the wearer. For example, the period of time that an air-purifying device is effective for removing a harmful substance from air when it is breathed.

Smoke means a system that includes the products of combustion, pyrolysis, or chemical reaction of substances in the form of visible and invisible solid and liquid particles and gaseous products in air. Smoke is usually of sufficient concentration to perceptibly obscure vision.

Sorbent is the material contained in a cartridge or canister that removes gases and vapors from the inhaled air.

Spray means a liquid, mechanically-produced particle with sizes generally in the visible.

Supplied-air respirator (SAR) or airline respirator means an atmosphere-supplying respirator for which the source of breathing air is drawn from a separate, stationary system or an uncontaminated environment.

Tight-fitting facepiece means a respiratory inlet covering that forms a complete seal with the face.

Time-weighted average (TWA) means the average concentration of a contaminant in air during a specific time period.

User seal check means an action conducted by the respirator user to determine if the respirator is properly seated to the face.

Valve (air or oxygen) means a device that controls the pressure, direction, or rate of flow of air or oxygen.

Window indicator means a device on a cartridge or canister that visually denotes the service life of the cartridge or canister.

You means the employer or the employer's designee except in WAC 296-62-07117(2) "Important Information About Voluntary Use of Respirators" when you refers to the employee.

Your refers to the employer or the employer's designee except in WAC 296-62-07117(2) "Important Information About Voluntary Use of Respirators" when your refers to the employee.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06) § 296-62-07105, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07105, filed 05/04/99, effective 09/01/99. [Statutory Authority: Chapter 49.17 RCW. 95-04-007, § 296-62-07105, filed 1/18/95, effective 3/1/95; 94-15-096 (Order 94-07), § 296-62-07105, filed 7/20/94, effective 9/20/94; 93-19-142 (Order 93-04), § 296-62-07105, filed 9/22/93, effective 11/1/93; 91-24-017 (Order 91-07), § 296-62-07105, filed 11/22/91, effective 12/24/91. RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07105, filed 7/27/81.]

Respiratory Protection Program

WAC 296-62-07107 When is a respiratory protection program required?

(1) In any workplace where respirators are necessary to protect the health of the employee or whenever you require respirator use, you must develop and implement a written respiratory protection program with worksite-specific procedures and specifications for required respirator use.

(2) Upon request, you must provide the director's representative a copy of your written respiratory protection program.

Note: OSHA's Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide will be available from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07107, filed 05/04/99, effective 09/01/99. [Statutory Authority: Chapters 49.17 RCW. 90-09-026 (Order 90-01), § 296-62-07107, filed 4/10/90, effective 5/25/90.] [Statutory Authority: RCW 49.17.040 and 49.17.050. 82-03-023 (Order 82-1), § 296-62-07107, filed 1/15/82.] [Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07107, filed 7/27/81.]

WAC 296-62-07109 When must you update your written respiratory protection program? The program must be updated as necessary to reflect those changes in workplace conditions that may affect respirator use.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07109, filed 05/04/99, effective 09/01/99.] [Statutory Authority: RCW 49.17.040 and 49.17.050. 82-13-045 (Order 82-22), § 296-62-07109, filed 6/11/82; 82-03-023 (Order 82-1), § 296-62-07109, filed 1/15/82.] [Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07109, filed 7/27/81.]

WAC 296-62-07111 What must be included in your written respiratory protection program? Include the following provision in your written program, as applicable:

- Procedures for selecting respirators for use in the workplace and a list identifying the proper type of respirator for each respiratory hazard (see WAC 296-62-07130 through 296-62-07133);
- Medical evaluations of employees required to use respirators (see WAC 296-62-07150 through 296-62-07156);
- Fit testing procedures for tight-fitting respirators (see WAC 296-62-07160 through 296-62-07162, and WAC 296-62-07201 through 296-62-07248, Appendices A-1, A-2, and A-3);
- Procedures for proper use of respirators in routine tasks, nonroutine tasks, reasonably foreseeable emergency and rescue situations (see WAC 296-62-07170 through 296-62-07172);
- Procedures for issuing the proper type of respirator based on the respiratory hazards for each employee;
- Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators (see WAC 296-62-07175 through 296-62-07179 and WAC 296-62-07253);
- Procedures to make sure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators (see WAC 296-62-07182);
- Training of employees in the respiratory hazards to which they are potentially exposed during routine, nonroutine, and unforeseeable emergency and rescue situations (see WAC 296-62-07188);
- Training of employees in the proper use of respirators, including putting on and removing them, any limitations on their use, and their maintenance (see WAC 296-62-07188); and
- Procedures for regularly evaluating the effectiveness of the program (see WAC 296-62-07192).

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07111, filed 05/04/99, effective 09/01/99. [Statutory Authority: RCW 49.19.040, 49.17.,050 and 49.17.240. 81-16-016 (Order 81-19) § 296-62-07111, filed 7/27/81.]

WAC 296-62-07113 What are the requirements for a program administrator?

You must designate a program administrator qualified by training or experience appropriate to the needs of your program to:

- Oversee the respiratory protection program; and
- Conduct the required evaluations of program effectiveness.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07113, filed 05/04/99, effective 09/01/99.] [Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, § 296-62-07113, filed 9/5/97, effective 11/5/97.] [Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), § 296-62-07113, filed 11/22/91, effective 12/24/91; 88-14-108 (Order 88-11), § 296-62-07113, filed 7/6/88. [Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07113, filed 7/27/81.]

WAC 296-62-07115 Who pays for the respirators, training, medical evaluations, and fit testing?

When respirators are required, you must provide respirators, training, medical evaluations, and fit testing at no cost to your employees (including expenses such as wages and travel). For voluntary use, see WAC 296-62-07117(3).

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07115, filed 05/04/99, effective 09/01/99.] [Statutory Authority: Chapter 49.17 RCW. 88-14-108 (Order 88-11), § 296-62-07115, filed 7/6/88.] [Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), § 296-62-07115, filed 11/30/83; 82-08-026 (Order 82-10), § 296-62-07115, filed 3/30/82. [Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07115, filed 7/27/81.]

Voluntary Use Of Respirators

WAC 296-62-07117 What must you do when employees choose to wear respirators when respirators are not required?

(1) You may provide respirators at the request of employees or permit employees to use their own respirators, if you determine that such respirator use will not in itself create a hazard.

(2) If you determine that any voluntary respirator use is permissible, you must provide the respirator users with the following information:

Figure 1 Important Information About Voluntary Use of Respirators

*Note: **"You"** and **"your"** mean the employee in the following information.*

Respirators protect against airborne contaminants when properly selected and worn. Respirator use is encouraged, even when exposure to contaminants are below the exposure limit(s), to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to you. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous contaminants (chemical & biological) does not exceed the limits set by WISHA standards. If your employer provides respirators for your voluntary use, or if you are allowed to provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard.

You should do the following:

1. Read and follow all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.
2. Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.
3. Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against solvent vapor or smoke (since smoke particles are much smaller than dust particles).
4. Keep track of your respirator so that you do not mistakenly use someone else's respirator.

Spanish version

Ilustración 1 información importante sobre el uso voluntario de respiradores

*Nota: " **Usted** " y " **su** " en la información siguiente se refiere al empleado.*

Los respiradores protegen contra contaminantes aerotransportados cuando son seleccionados y usados correctamente. Para proporcionar un nivel adicional de comodidad y de protección para los trabajadores, el uso del respirador es recomendado, incluso cuando las exposiciones a los contaminantes están bajo del limite de exposición. Sin embargo, si un respirador se utiliza incorrectamente o no se mantiene limpio, el respirador en sí mismo puede convertirse en un peligro para usted. A veces, los trabajadores pueden usar respiradores para evitar exposiciones a los peligros, incluso si la cantidad de contaminantes peligrosos (químicos y biológicos) no exceden los límites mandados por las reglas de WISHA. Si su patrón le proporciona los respiradores para el uso voluntario, o si se le permite proporcionar su propio respirador, usted necesita tomar ciertas precauciones para asegurarse que el respirador en sí mismo no presente un peligro.

Usted debe de hacer lo siguiente:

1. Lea y siga todas las instrucciones proporcionadas por el fabricante en el uso, mantenimiento, limpieza, cuidado, y advertencias con respecto a las limitaciones de los respiradores.
2. Elija los respiradores certificados que le protejan contra el contaminante que está usando. NIOSH, (siglas en Inglés) Instituto Nacional para la Seguridad y Salud Ocupacional del Departamento de la Salud y Servicios Humanos de los Estados Unidos, certifica los respiradores. Una etiqueta o una declaración de la certificación debe aparecer en el respirador o en el empaquetado con el del respirador. La etiqueta o declaración le explicará para lo que fue diseñado el respirador y cuánta protección le ofrece.
3. No use el respirador en atmósferas que contenegan contaminantes para los cuales su respirador no fue diseñado. Por ejemplo, un respirador diseñado para filtrar partículas de polvo no le protegerá contra vapores o humo (ya que las partículas del humo son mucho más pequeñas que partículas de polvo).
4. Marque su respirador de una forma para que usted no utilice equivocadamente el respirador de otra persona.

(3) No respiratory program is required when filtering-facepiece respirators are the only respirator used and they are used voluntarily. When any other type of respirator is used voluntarily, you must establish, implement, and pay for a written program that covers:

- Medical evaluations.
- Cleaning, storage and maintenance related program elements.

[Statutory Authority: RCW 49.17.010, .040, .050. 0021-100 (Order 00-06), § 296-62-07117, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07117, filed 05/04/99, effective 09/01/99.]
[Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), § 296-62-07117, filed 7/27/81.]

Respirator Selection

WAC 296-62-07130 What must be considered when selecting any respirator?

(1) You must identify and evaluate the respiratory hazard(s) in the workplace. This evaluation must reasonably estimate employee exposures to respiratory hazard(s) and identify the contaminant's chemical state and physical form. Where you cannot identify or reasonably estimate the employee exposure, you must consider the atmosphere to be IDLH.

(2) You must identify relevant factors pertaining to the workplace and respirator user that affect respirator performance and reliability.

(3) You must select and provide the appropriate respirators based on the respiratory hazards and the relevant factors related to the workplace and user.

(4) You must select a NIOSH-certified respirator. The respirator must be used in compliance with the conditions of its certification.

(5) You must select respirators from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07130, filed 05/04/99, effective 09/01/99.

WAC 296-62-07131 What else must you consider when selecting a respirator for use in atmospheres that are not IDLH?

(1) You must provide a respirator that is adequate to protect the health of the employee and ensure compliance with all other WISHA statutory and regulatory requirements for routine, nonroutine, and reasonably foreseeable emergency and rescue situations.

(2) You must use the assigned protection factors (APFs) in Table 1 when selecting respirators.

Note: The APF values listed in Table 1 do not apply when respirator selection is specified by other applicable standards (e.g., asbestos, lead standards in chapter 296-62 WAC).

Table 1--Assigned Protection Factors

Type of Respirator	**Assigned Protection Factor**[a]
Air-Purifying Respirators (APRs)	
Half-facepiece[b] for: • Particulate-filter • Vapor- or gas-removing • Combination particulate-filter and vapor- or gas-removing	10
Full facepiece for: • Particulate-filter; • Vapor- or gas-removing; • Combination particulate-filter and vapor- or gas-removing	100
Powered Air-Purifying Respirators (PAPRs)	
Powered air-purifying, loose fitting facepiece	25
Powered air-purifying , half facepiece	50
Powered air-purifying, full facepiece, equipped with HEPA filters or sorbent cartridges or canisters	1000
Powered air-purifying, hood or helmet equipped with HEPA filters or sorbent cartridges or canisters.	1000
Supplied-Air (Airline) Respirators	
Supplied-air, demand, half facepiece	10
Supplied-air, continuous-flow, loose fitting facepiece	25
Supplied-air, continuous-flow or pressure-demand type, half facepiece	50
Supplied-air, demand, full facepiece	100
Supplied-air, continuous-flow or pressure-demand type, full facepiece	1000
Supplied-air, continuous-flow, helmet or hood	1000
Self-Contained Breathing Apparatus (SCBAs)	
Self-contained breathing apparatus, demand-type, half facepiece[b]	10
Self-contained breathing apparatus, demand-type, full facepiece	100
Self-contained breathing apparatus, pressure-demand type, full facepiece	10,000

Combination respirators. For combination respirators (such as, airline respirators with an air-purifying filter), the type and mode of operation having the lowest respirator protection factor must be applied to the combination respirator not listed.

[a] An assigned protection factor (APF) is a numeric rating given to respirators, which tells how much protection the respirator can provide. Multiplying the WISHA permissible exposure limit (PEL) for a contaminant by the respirator APF gives the maximum concentration of the contaminant for which the respirator can be used. PEL values can be found in chapter 296-62 WAC, Part H.

[b] If the air contaminant causes eye irritation, the wearer of a respirator equipped with a quarter-mask or half-mask facepiece or mouthpiece and nose clamp must be permitted to use a protective goggle or to use a respirator equipped with a full facepiece. Mouthpiece and nose clamp respirators are approved by NIOSH only for escape from IDLH atmospheres.

WAC 296-62-07131 (Cont.)

(3) The respirator selected must be apropriate for the chemical state and physical form of the contaminant.

(4) For protection against gases and vpors, you must provide an atmosphere-supplying respirator or an air-purifying respirator, provided that:

- The respirator is equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; or
- If there is no ESLI appropriate for the conditions in your workplace, you must implement a change schedule for canisters and cartridges that is based on objective information or data that will make sure that canisters and cartridges are changed before the end of their service life. Your respirator program must describe:
  - The information and data relied upon; and
  - The basis for the canister and cartridge change schedule; and
  - The basis for reliance on the data.

(5) For protection against particulates, you must provide:

- An atmosphere-supplying respirator; or
- An air-purifying respirator equipped with a filter certified by NIOSH under 30 CFR Part 11 as a high efficiency particulate air (HEPA) filter, or an air-purifying respirator equipped with a filter certified for particulates by NIOSH under 42 CFR Part 84; or
- An air-purifying respirator equipped with any filter certified for particulates by NIOSH for contaminants consisting primarily of particles with mass median aerodynamic diameters (MMAD) of at least 2 micrometers; or
- For filters to be changed as required in WAC 296-62-07171(4).

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06), § 296-62-07131, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07131, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07132 What else must you consider when selecting a respirator for use in IDLH atmospheres?

(1) You must provide the following respirators for your employees to use in IDLH atmospheres:

- A full facepiece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes; or
- A combination full facepiece pressure demand supplied-air respirator (SAR) with auxiliary self-contained air supply.

(2) Respirators provided only for escape from IDLH atmospheres must be NIOSH-certified for escape from the atmosphere in which they will be used.

(3) All oxygen-deficient atmospheres must be considered IDLH unless you demonstrate that, under all foreseeable conditions, the oxygen concentration can be maintained within the ranges specified in Table 2 of this section (i.e., for the altitudes set out in the table). In such cases, any atmosphere-supplying respirator may be used.

Table 2 Altitudes for Oxygen Deficient Atmospheres

Altitude (ft.)	Oxygen deficient atmospheres ($\%O_2$) for which the employer may rely on any atmosphere-supplying respirator
Less than 3,001	16.0 - 19.5
3,001 - 4,000	16.4 - 19.5
4,001 - 5,000	17.1 - 19.5
5,001 - 6,000	17.8 - 19.5
6,001 - 8,000	19.3 - 19.5

[1]Above 8,000 feet the exception does not apply. Oxygen-enriched breathing air must be supplied above 14,000 feet. [Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07132, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07133 What else must you consider when selecting a respirator for emergency and rescue use?

(1) You must analyze emergency and rescue uses of respirators that may occur in each operation by carefully considering materials, equipment, processes, and personnel involved in each operation. The person who is thoroughly familiar with the particular operation must review the analysis. As part of your analysis, you must:

- Consider past occurrences requiring emergency or rescue use of respirators as well as conditions that resulted in such respirator applications;
- Consider the possible consequences of equipment or power failures, uncontrolled chemical reactions, fire, explosion, or human error; and
- Based on the above considerations, list potential hazards that may result in emergency or rescue use of respirators.

(2) Based upon the analysis, you must:

- Select the appropriate types of respirators;
- Provide an adequate number of respirators for each area where they may be needed for emergency or rescue use; and
- Maintain and store the respirators so that they are readily accessible and operational when needed. [Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07133, filed 05/04/99, effective 09/01/99.]

Medical Evaluations

WAC 296-62-07150 What are the general requirements for medical evaluations? Before an employee is fit tested or required to use a respirator in the workplace, you must provide a medical evaluation to determine the employee's ability to use a respirator. Medical evaluations are not required:

- When the only respirators used are filtering facepiece respirators that are used voluntarily under WAC 296-62-07117; or
- When the only respirators used are loose fitting escape-only respirators.

WAC 296-62-07150 (Cont.)

You may rely upon a previous employer's medical evaluation, if you can show that:

- You have been provided with a copy of the written recommendation as required in WAC 296-62-07155 from the PLHCP approving the employee to use the respirator chosen; and
- The previous working conditions, which required respirator use as detailed in WAC 296-62-07154(1), are substantially similar to yours.

Steps necessary for completing a medical evaluation:

- You identify a PLHCP (WAC 296-62-07151);
- You provide information to the PLHCP (WAC 296-62-07152);
- PLHCP reviews information and determines what additional questions, if any, to add to Part A of the questionnaire (WAC 296-62-07153(2));
- You administer the questionnaire confidentially (WAC 296-62-07153 (3) and (4));
- PLHCP reviews and evaluates the questionnaire (WAC 296-62-07154(1));
- PLHCP completes any follow-up medical evaluations with employees (WAC 296-62-07154 (2) and (3));
- PLHCP completes the written recommendation and sends it to the employee and you (WAC 296-62-07155 (1) and (2));
- You respond appropriately to written recommendations (WAC 296-62-07155(2)) and maintain records (WAC 296-62-07194);
- You provide additional medical evaluations when required by your PLHCP (WAC 296-62-07156).

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06), § 296-62-07150, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07150, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07151 Who must perform medical evaluations? You must identify a physician or other licensed health care professional (PLHCP) to perform medical evaluations.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07151, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07152 What information must you provide to the PLHCP in addition to the questionnaire? You must provide the following information to the PLHCP before the PLHCP makes a recommendation concerning an employee's ability to use a respirator:

- The questionnaire found in WAC 296-62-07255, Appendix C;
- The type and weight of the respirator to be used by the employee;
- The duration and frequency of respirator use (including use for rescue and escape);
- The expected physical work effort;
- Additional protective clothing and equipment to be worn;
- Temperature and humidity extremes that may be encountered;
- A copy of your written respiratory protection program (including, but not limited to, a list of respirators as required in WAC 296-62-07111(1) and fit testing procedures as required in WAC 296-62-07111(3)); and
- A copy of chapter 296-62 WAC, Part E, Respiratory protection.

When an employee needs a subsequent medical evaluation, you do not have to provide any information previously given to the PLHCP if the information and the PLHCP remain the same.

Note: When you change your PLHCP, you must make sure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. WISHA does not expect you to have employees medically reevaluated solely because a new PLHCP has been selected.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07152, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07153 How must the medical evaluations and the questionnaire be administered?

(1) An initial evaluation must be completed. You may use the questionnaire in WAC 296-62-07255. It is not necessary to have an initial medical examination. However, an initial medical examination may be substituted for the questionnaire if it obtains the same information. Questions in Section 1 and 2 of Part A must be answered by all respirator users, while questions in Section 3 must be answered by SCBA and full facepiece respirator users. The PLHCP determines what additional questions must be used in the questionnaire from Part B in WAC 296-62-07255.

(2) The medical questionnaire and examinations must be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee.

Confidentiality. The medical questionnaire must be administered in a way that makes sure that the employee understands its content. To ensure confidentiality, you must not review an employee's questionnaire at any time. This includes looking at the completed questions or any other interaction that may be considered a breach of confidentiality.

The following are different options that may be used to administer questionnaires confidentially:

- You may administer the questionnaire and arrange for employee access to a PLHCP if there are any questions. For example, you may provide employees a copy of the questionnaire, ask them to fill it out, and place it in a sealed envelope that is sent to the PLHCP.
- Your PLHCP may administer the questionnaire.
- You may hire a third party to confidentially administer the questionnaire.

(3) You must provide the employee with an opportunity to discuss the questionnaire and examination results with the PLHCP.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07153, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07154 Who must review the questionnaire and determine what, if any, follow-up evaluations are needed?

You must provide for the following PLHCP evaluations.

- For the initial medical evaluation, the PLHCP must review the information obtained by the questionnaire in WAC 296-62-07255.
- The PLHCP must provide a follow-up medical evaluation for any employee who gives a positive response to any one of questions 1 through 8 in Section 2 of Part A in WAC 296-62-07255 or whose initial medical evaluation demonstrates the need for follow-up evaluation.
- The follow-up medical evaluation must include any consultations (for example, a telephone conversation to evaluate positive responses on the questionnaire), medical tests, or diagnostic procedures that the PLHCP deems necessary to make a final determination.

Note: When you replace a PLHCP, you must make sure that the new PLHCP obtains this information, either by providing the documents directly to the PLHCP or having the documents transferred from the former PLHCP to the new PLHCP. However, WISHA does not expect you to have employees medically reevaluated solely because a new PLHCP has been selected.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07154, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07155 What must be included in the PLHCP's written recommendation?

(1) In determining the employee's ability to use a respirator, you must obtain a written recommendation regarding the employee's ability to use the respirator from the PLHCP. The recommendation must provide only the following information about the employee:

- Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator;

- The need, if any, for periodic future medical evaluations; and
- A statement that the PLHCP has provided the employee with a copy of the PLHCP's written recommendation.

(2) You must provide a PAPR, if:

- The respirator is a negative pressure respirator and the PLHCP finds a medical condition that may place the employee's health at increased risk if the respirator is used;
- The PLHCP's medical evaluation finds that the employee can use such a respirator. You no longer must provide a PAPR, if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06), § 296-62-07155, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07155, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07156 When are future medical evaluations required? At a minimum, you must provide future medical evaluations that comply with the requirements in WAC 296-62-07151 through 296-62-07155 if:

- A PLHCP recommends that an employee be reevaluated at a set interval;
- An employee reports medical signs or symptoms related to his or her ability to use a respirator;
- A supervisor, or the respirator program administrator informs you that an employee needs to be reevaluated;
- Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation; or
- A change occurs in workplace conditions (for example, physical work effort, protective clothing, temperature) that may result in a substantial increase in the physiological burden placed on an employee.

You may discontinue an employee's medical evaluations when the employee is no longer required to use a respirator.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06), § 296-62-07156, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07156, filed 05/04/99, effective 09/01/99.]

Fit Testing

WAC 296-62-07160 When is fit testing required? You must make sure that employees using a negative or positive pressure tight-fitting facepiece respirator pass an appropriate qualitative fit test (QLFT) or quantitative fit test (QNFT). Fit testing must occur:

- Prior to initial use of the respirator;
- Whenever a different respirator facepiece (size, style, model or make) is used;
- At least annually thereafter; and
- Whenever the employee reports to you or your PLHCP observes changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight.

You may rely on a current fit test completed by a previous employer for the same employee if you obtain written documentation of the fit test and all other applicable requirements in WAC 296-62-07160 through 296-62-07162 have been satisfied.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07160, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07161 What is required when an employee finds the respirator's fit unacceptable? If after passing a qualitative fit test or a quantitative fit test, your employee subsequently notifies you or your PLHCP that the fit of the respirator is unacceptable, you must give the employee a reasonable opportunity to select a different respirator facepiece and to be retested.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07161, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07162 How must fit testing be done?

(1) The fit test must be administered using WISHA-accepted quantitative or qualitative protocol. These protocols are contained in WAC 296-62-07201 through 296-62-07248 (Appendices A-1, A-2 and A-3 of this part).

(2) Qualitative fit testing may be used to fit test negative pressure air-purifying respirators only when they will be used in atmospheres where the concentration is less than 10 times the PEL. For negative pressure respirator use in concentrations equal to or greater than 10 times the PEL, quantitative fit testing must be used.

(3) If the fit factor, as determined through WISHA-accepted quantitative fit testing protocol, is equal to or greater than 100 for tight-fitting half facepieces, or equal to or greater than 500 for tight-fitting full facepieces, the employee passed the quantitative fit test for that respirator.

(4) Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators must be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.

(a) Qualitative fit testing of these respirators must be accomplished by temporarily converting the respirator user's actual facepiece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator facepiece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator facepiece.

(b) Quantitative fit testing of these respirators must be accomplished by modifying the facepiece to allow sampling inside the facepiece in the breathing zone of the user, midway between the nose and mouth. This requirement must be accomplished by installing a permanent sampling probe onto a surrogate facepiece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the facepiece.

(c) Any modifications to the respirator facepiece for fit testing must be completely removed, and the facepiece restored to NIOSH-approved configuration, before that facepiece can be used in the workplace.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06), § 296-62-07162, filed 10/18/00/ effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07162, filed 05/04/99, effective 09/01/99.]

Use Of Respirators

WAC 296-62-07170 How must you prevent problems with the seal on tight-fitting facepieces?

(1) You must not permit respirators with tight-fitting facepieces to be worn during fit testing and respirator use by employees who have:

- Any facial hair that is visibly projecting above the skin (stubble, moustache, sideburns, portions of a beard, low hairline, bangs) that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
- Any other condition that interferes with the face-to-facepiece seal or valve function.

(2) If an employee wears corrective glasses or goggles or other personal protective equipment, you must make sure that such equipment is worn in a manner that does not interfere with the seal of the facepiece.

(3) For all tight-fitting respirators, you must make sure that employees perform a user seal check each time they put on the respirator using the procedures in Appendix B-1 or procedures recommended by the respirator manufacturer that you demonstrate are as effective as those in Appendix B-1 of chapter 296-62 WAC, Part E.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07170, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07171 How do you monitor continuing effectiveness of your employees' respirators?

(1) You must maintain appropriate surveillance of work area conditions and degree of employee exposure or stress.

(2) When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, you must reevaluate the continued effectiveness of the respirator.

(3) You must make sure that employees leave the respirator use area:

- To wash their faces and respirator facepieces as necessary to prevent eye or skin irritation associated with respirator use; or
- If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece; or
- To replace the respirator or the filter, cartridge, or canister elements; or
- If the employee experiences severe discomfort in wearing the respirator; or
- If the employee becomes ill or experiences sensations of dizziness, nausea, weakness, breathing difficulty, coughing, sneezing, vomiting, fever, and chills.

(4) If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the facepiece, you must replace or repair the respirator before allowing the employee to return to the work area.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07171, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07172 What are the standby procedures when respirators are used in IDLH situations?

(1) You must provide standby employees when employees are working in IDLH atmospheres.

In certain IDLH situations, one standby employee is permitted when the IDLH atmosphere is well characterized and you can show that one employee can adequately:

- Monitor the employee(s) in the IDLH atmosphere;
- Implement communication activities; and
- Initiate rescue duties.

For all other IDLH situations, you must have at least two employees located outside the IDLH atmosphere.

(2) Visual, voice, or signal line communication must be maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.

(3) The employee(s) located outside the IDLH atmosphere must be trained and equipped to provide effective emergency rescue.

(4) You or your designee must be notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue.

(5) You or your designee, once notified, must provide necessary assistance appropriate to the situation.

(6) Standby employee(s) located outside the IDLH atmospheres must be equipped with:

(a) Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either

(b) Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or equivalent means for rescue where retrieval equipment is not required.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07172, filed 05/04/99, effective 09/01/99.]

Maintenance and Care of Respirators

WAC 296-62-07175 How must respirators be cleaned and disinfected?

(1) You must provide each respirator user with a respirator that is clean, sanitary, and in good working order.

(2) You must make sure that respirators are cleaned and disinfected using the procedures in WAC 296-62-07253, Appendix B-2, or procedures recommended by the respirator manufacturer, provided that such procedures are as effective.

(3) The respirators must be cleaned and disinfected as follows:

- Respirators issued for the exclusive use of an employee must be cleaned and disinfected as often as necessary to be maintained in a sanitary condition;
- Respirators issued to more than one employee must be cleaned and disinfected before being worn by different individuals;
- Respirators maintained for emergency use must be cleaned and disinfected after each use, and
- Respirators used in fit testing and training must be cleaned and disinfected before being worn by a different employee.

[Statutory Authority: RCW 49.17.010, 0.40, .050. 99-10 (Order 98-10) § 296-62-07175, filed o5/04/99, effective 09/01/99.]

WAC 296-62-07176 How must respirators be stored?

(1) You must make sure that all respirators are stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. You must also make sure that they are packed or stored to prevent deformation of the facepiece and exhalation valve.

(2) When storing emergency respirators.

(a) You must keep respirators accessible to the work area.

(b) You must store respirators in compartments or in covers that are clearly marked as containing emergency respirators.

(c) You must store respirators in accordance with any applicable manufacturer instructions.

(d) You must provide an adequate number of respirators for each work area where they may be needed.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07176, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07177 When must respirators be inspected? You must make sure that:

- All respirators used in routine situations are inspected before each use and during cleaning;
- All respirators maintained for use in emergency situations are inspected at least monthly and in accordance with the manufacturer's recommendations, and are checked for proper function before and after each use;
- Emergency escape-only respirators are inspected before being carried into the workplace for use; and
- Self-contained breathing apparatus (SCBAs) must be inspected monthly.

[Statutory Authority: RCW 49.17.010, .0450, .050. 99-10 (Order 98-10) § 296-62-07177, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07178 How must respirators be inspected and maintained?

(1) You must make sure that respirator inspections include:

- A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the facepiece, head straps, valves, connecting tube, and cartridges, canisters or filters; and
- A check of elastomeric parts for pliability and signs of deterioration.

(2) For self-contained breathing apparatus you must:

- Maintain air and oxygen cylinders in a fully charged state and recharge the cylinders when the pressure falls to 90% of the manufacturer's recommended pressure level; and
- Determine that the regulator and warning devices function properly.

(3) For respirators maintained for emergency use, you must:

- Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator; and
- Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports compartment for the electronic files. This information must be maintained until replaced following a subsequent certification.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 99-10), § 296-62-07178, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07179 How must respirators be repaired and adjusted?

(1) You must make sure that respirators that fail an inspection or are otherwise found to be defective are no longer used until they are repaired or adjusted properly;

(2) Repairs or adjustments to respirators must be made only by persons appropriately trained to perform such operations, who must use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;

(3) Repairs must be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and

(4) Reducing and admission valves, regulators, and alarms must be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07179, filed 05/04/99, effective 09/01/99.]

Breathing Air Quality

WAC 296-62-07182 What are the breathing gas requirements for atmosphere-supplying respirators?

(1) You must provide employees using atmosphere-supplying respirators (supplied-air and SCBA) with breathing gases of high purity.

(2) You must make sure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:

- Compressed and liquid oxygen must meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and

- Compressed breathing air must meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:
  - Oxygen content (v/v) of 19.5-23.5%;
  - Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;
  - Carbon monoxide (CO) content of 10 ppm or less;
  - Carbon dioxide content of 1,000 ppm or less; and
  - Lack of noticeable odor.

(3) You must make sure that compressed oxygen is not used in atmosphere-supplying respirators that have previously used compressed air.

(4) You must make sure that oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.

(5) Cylinders used to supply breathing air to respirators.

(a) Cylinders must be tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR Part 173 and Part 178);

(b) Cylinders of purchased breathing air must have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air; and

(c) The moisture content in the cylinder must not exceed a dew point of -50. ° F (-45.6°C) at 1 atmosphere pressure.

(6) Compressors used to supply breathing air to respirators.

(a) Compressors must be constructed and situated so as to prevent entry of contaminated air into the air-supply system.

(b) Compressors must minimize moisture content so that the dew point at 1 atmosphere pressure is 10°F (5.56C) below the ambient temperature.

(c) Compressors must have suitable in-line air-purifying sorbent beds and filters to further make sure that the supplied-air is breathing air quality. Sorbent beds and filters must be maintained and replaced or refurbished periodically following the manufacturer's instructions.

(d) Compressors must have a tag containing the most recent sorbent bed and filter change date and the signature of the person authorized by the employer to perform the change. The tag must be maintained at the compressor.

(7) For compressors that are not oil-lubricated, you must make sure that carbon monoxide levels in the breathing air do not exceed 10 ppm.

(8) For oil-lubricated compressors, you must use a high-temperature or carbon monoxide alarm, or both, to monitor carbon monoxide levels. If only high-temperature alarms are used, the air supply must be monitored at intervals sufficient to make sure the concentration of carbon monoxide in the breathing air does not exceed 10 ppm.

(9) You must make sure that breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems. Asphyxiating substances must not be introduced into breathing air lines.

(10) You must use breathing gas containers marked in accordance with the NIOSH respirator certification standard, 42 CFR Part 84.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07182, filed 05/04/99, effective 09/01/99.]

Identification Of Filters, Cartridges And Canisters

WAC 296-62-07184 How must filters, cartridges and canisters be labeled? You must make sure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label. The label must not be removed and must remain legible. Table 3 provides information about color coding for air-purifying respirator filters, cartridges, and canisters.

TABLE 3 -- Color Coding of Respirator Filters, Cartridges and Canisters

Atmospheric Contaminants to be Protected Against	Colors Assigned.*
Acid gases	White.
Hydrocyanic acid gas	White with 1/2 - inch green stripe completely around the canister near the bottom.
Chlorine gas	White with 1/2 - inch yellow stripe completely around the canister near the bottom.
Organic vapors	Black.
Ammonia gas	Green.
Acid gases and ammonia gas	Green with 1/2 - inch white stripe completely around the canister near the bottom.
Carbon monoxide	Blue.
Acid gases and organic vapors	Yellow.
Hydrocyanic acid gas and chloropicrin vapor	Yellow with 1/2 - inch blue stripe completely around the canister near the bottom.
Acid gases, organic vapors, and ammonia gases	Brown.
Radioactive materials, excepting tritium and noble gases	Purple (Magenta).
Particulates (dusts, fumes, mists, fogs, or smokes) in combination with any of the above cases or vapors	Canister color for contaminant, as designated above, with 1/2 - inch gray stripe completely around the canister near the top.
All of the above atmospheric contaminants	Red with 1/2 - inch gray stripe completely around the canister near the top.

*Gray must not be assigned as the main color for a canister designed to remove acids or vapors. Note: Orange must be used as a complete body, or stripe color to represent gases not included in this table. The user will need to refer to the canister label to determine the degree of protection the canister will afford.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07184, filed 05/04/99, effective 09/01/99.]

Training and Information

WAC 296-62-07186 What are the general training requirements?

(1) You must provide effective training to:

- Employees required to use respirators;
- Supervisors; and
- Any person issuing respirators.

(2) The training must be done so your employees understand it.

(3) The training must be provided by qualified persons.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07186, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07188 How do you know if you adequately trained your employees? At a minimum, you must make certain that each employee can demonstrate:

- Why the respirator is necessary and how improper fit, use, or maintenance can compromise the protective effect of the respirator;
- What the respirator is capable of doing and what its limitations are;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- How to inspect (see WAC 296-62-07178), put on and remove, use (see WAC 296-62-07170 through 296-62-07172), and check the seals (see WAC 296-62-07251) of the respirator;
- The procedures for maintaining (see WAC 296-62-07175 through 296-62-07179, 296-62-07182(5) and 296-62-07253) and storing (see WAC 296-62-07176) of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- The general requirements of chapter 296-62 WAC, Part E.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10), § 296-62-07188, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07190 When must your employees be trained?

(1) You must train employees before they are required to use a respirator in the workplace.

(2) If you are able to demonstrate that a new employee has received training within the last 12 months that addresses the elements specified in WAC 296-62-07172 and 296-62-07186, then you are not required to repeat the training provided that the employee can demonstrate knowledge of the element(s) required in WAC 296-62-07188.

(3) If you do not repeat initial training for an employee, then you must provide retraining no later than 12 months from the date of the employee's previous training.

(4) Retraining must be completed annually, and when the following situations occur:

- Changes in the workplace or the type of respirator render previous training obsolete or incomplete;
- The employee's knowledge or use of the respirator indicates that the employee has not retained the understanding or skill as required in WAC 296-62-07188 above; or
- Any other situation arises when retraining appears to be necessary to make sure respirators are used safely.

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06), § 296-62-17190, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10), § 296-62-07190, filed 05/04/99, effective 09/01/99.]

Program Evaluation

WAC 296-62-07192 How must you evaluate the effectiveness of your respiratory protection program?

(1) You must evaluate the workplace as necessary to make sure that the requirements of the current written program are being effectively carried out and that the program continues to be effective.

(2) Evaluation must include periodic monitoring by the supervisor to make sure respirators are properly worn.

(3) You must regularly ask employees required to use respirators their views on the program's effectiveness and use their input to identify any problems. Any problems identified must be corrected. At a minimum, you must evaluate the following factors:

- Respirator fit (including the employee's ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the employee is exposed;
- Proper respirator use under the workplace conditions the employee encounters; and
- Proper respirator maintenance.

(4) Medical and bioassay surveillance. When appropriate, medical surveillance, including bioassays, must be carried out to determine if employees using respirators are receiving adequate respiratory protection. A physician must determine the requirements of the surveillance program.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07192, filed 05/04/99, effective 09/01/99.]

Recordkeeping

WAC 296-62-07194 What are the recordkeeping requirements?

(1) General. You must keep written records of the following:

- Written recommendations from the PLHCP;
- Fit testing;
- The respirator program; and
- Training.

(2) Access to medical records. You must make the written recommendations from the PLHCP and any other medical records you are maintaining available as required by chapter 296-62 WAC, Part B.

(3) Fit testing. You must keep a record of any qualitative and quantitative fit tests completed for each employee. The record must include:

- The name or identification of the employee tested;
- Type of fit test performed;
- Specific make, model, style, and size of respirator tested;
- Date of test; and
- The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs.

Fit test records must be retained for respirator users until the next fit test is administered.

(4) You must keep a written copy of the current respirator program.

(5) You must keep written training records that include:

- Names of the employees trained; and
- The dates when the employees were trained.

(6) Written materials required by this part must be made available upon request for examination and copying to affected employees and to the director or the director's designee.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07194, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07201 Appendix A-1: General Fit Testing Requirements for Respiratory Protection--Mandatory. This is a mandatory appendix to chapter 296-62 WAC, Part E, which includes WAC 296-62-07201 through 296-62-07203.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07201, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07202 What are the general requirements for fit testing?

(1) You must conduct fit testing using the procedures found in appendices A-1 through A-3. The requirements in these appendices apply to all WISHA-accepted qualitative (QLFT) and quantitative (QNFT) fit test methods.

(2) You must allow your employees to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

(3) Prior to selecting a respirator, you must show your employees how to:

- Put on a respirator;
- Positioned the respirator on the face;
- Set strap tension; and
- Determine an acceptable fit.

(4) You must provide a mirror for your employees to use when evaluating the fit and positioning of the respirator. This instruction does not constitute your employees' formal training on respirator use, because it is only a review.

(5) You must inform your employees that:

- They are being asked to select the respirator that provides the most acceptable fit;
- Each respirator represents a different size and shape; and
- If fitted and used properly, each respirator will provide adequate protection.

(6) You must have your employees hold each chosen facepiece up to their face and eliminate those that obviously do not give an acceptable fit.

(7) You must note the more acceptable facepieces in case the one selected proves unacceptable. The most comfortable mask must be put on and worn at least five minutes to make sure it is comfortable. You must help your employee assess comfort by discussing the points in subsection (8) of this section. If the employee is not familiar with using a particular respirator, have the employee put on the mask several times and adjust the straps each time to become adept at setting proper tension on the straps.

(8) You must review how to assess the comfort of a respirator by reviewing the following points with the employee and allowing the employee enough time to check the comfort of the respirator chosen:

(a) Position of the mask on the nose;

(b) Room for eye protection;

(c) Room to talk;

(d) Position of mask on face and cheeks.

(9) You must use the following criteria to determine if the respirator adequately fits each employee:

(a) Chin properly placed;

(b) Adequate strap tension, not overly tightened;

(c) Fit across nose bridge;

(d) Respirator of proper size to span distance from nose to chin;

(e) Tendency of respirator to slip;

(f) Self-observation in mirror to evaluate fit and respirator position.

(10) The employees must complete a user seal check. They must use either the negative and positive pressure seal checks described in WAC 296-62-07251, Appendix B-1 or those recommended by the respirator manufacturer that provide equivalent protection to the procedures in WAC 296-62-07251, Appendix B-1. Before conducting the negative and positive pressure checks, the employee must be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece must be selected and retested if the employee's respirator fails the user seal check tests.

(11) You must not conduct the fit test if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, mustache or sideburns that cross the respirator sealing surface. Any type of apparel that interferes with a satisfactory fit must be altered or removed.

(12) If the employee has difficulty in breathing during the tests, you must refer the employee to a physician or other licensed health care professional, as appropriate, to determine whether the employee can wear respirators while performing the employee's duties.

(13) If the employee finds the fit of the respirator unacceptable, you must give the employee the opportunity to select a different respirator and the employee must be retested.

(14) Prior to starting the fit test, you must describe the:

- Fit test to the employee;
- Employee's responsibilities during the test procedure; and
- Test exercises that the employee will be performing.

(15) The employee must wear the respirator at least 5 minutes before starting the fit test.

(16) When performing the fit test, you must have your employee wear any applicable safety equipment that may be worn during actual respirator use that could interfere with respirator fit.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07202, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07203 What are the fit test exercise requirements?

(1) You must have your employees perform the following test exercises for all fit testing methods required in the appendices for Respiratory Protection Part E, except for the controlled negative pressure (CNP) testing. The CNP protocol contains a different fit testing exercise regimen. The employee must perform exercises, in the test environment, in the following ways:

(a) Normal breathing. In a normal standing position, without talking, the employee must breathe normally.

(b) Deep breathing. In a normal standing position, the employee must breathe slowly and deeply, taking caution so as not to hyperventilate.

(c) Turning head side to side. Standing in place, the employees must slowly turn their heads from side to side between the extreme positions on each side, holding their heads at each extreme momentarily so they can inhale at each side.

(d) Moving head up and down. Standing in place, the employees must slowly move their heads up and down, inhaling in the up position (when looking toward the ceiling).

(e) Talking. The employee must talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The employee can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(f) Grimace. The employee must grimace by smiling or frowning (this applies only to QNFT testing; it is not performed for QLFT).

(g) Bending over. Employees must bend at their waist as if they were touching their toes. Jogging in place must be substituted for this exercise in those test environments such as shroud type QNFT or QLFT units that do not permit bending over at the waist.

(h) Normal breathing. Repeat exercise (a) for normal breathing.

(2) Each test exercise must be performed for one minute except for the grimace exercise, which must be performed for 15 seconds.

(3) You must question the employee about the comfort of the respirator after completing the test exercises. If the respirator has become unacceptable, you must try another model of respirator.

(4) Any adjustments during fit testing will void the test, making it necessary to begin again.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07203, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07205 Appendix A-2: Qualitative Fit Testing (QLFT) Protocols for Respiratory Protection--Mandatory. This is a mandatory appendix to chapter 296-62 WAC, Part E, which includes WAC 296-62-07205 through 296-62-07225.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07205, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07206 What are the general qualitative fit testing (QLFT) protocols?

(1) You must make sure the person who administers QLFT is able to:

- Prepare test solutions;
- Calibrate equipment and perform tests properly;
- Recognize invalid tests; and
- Make sure that test equipment is in proper working order.

(2) You must make sure that QLFT equipment is kept clean and well maintained so it operates within the parameters for which it was designed.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07206, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07208 Isoamyl acetate protocol (a QLFT).

Note: You must equip particulate respirators with an organic vapor cartridge or canister when using the isoamyl acetate protocol for fit testing.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07208, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07209 What are the odor threshold screening procedures for isoamyl acetate (QLFT)?

(1) Why use odor threshold screening?

Odor threshold screening, performed without wearing a respirator, determines if the employee tested can detect the odor of isoamyl acetate at low levels.

(2) How are the test solutions for odor threshold screening prepared?

(a) Use three 1 liter glass jars with metal lids.

(b) Use odor-free water (for example, distilled or spring water) at approximately 25°C (77°F) for preparing the solutions.

(c) Stock solution: Prepare the isoamyl acetate (IAA) (also known at isopentyl acetate) stock solution by:

- Adding 1 ml of pure IAA to 800 ml of odor-free water in a 1 liter jar;
- Closing the lid; and
- Shaking for 30 seconds.

A new stock solution must be prepared at least weekly.

(d) Daily test solution: Prepare the daily odor test solution in a second jar by placing 0.4 ml of the IAA stock solution into 500 ml of odor-free water using a clean dropper or pipette. Shake the solution for 30 seconds and allow it to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. The daily test solution must be used for only one day.

(e) Prepare a test blank in a third jar by adding 500 cc of odor-free water.

(f) Clearly label and identify the daily odor test solution and test blank jar lids (for example, 1 and 2). Place the labels on the lids so that they can be peeled off periodically and switched to maintain the integrity of the test.

(g) Prepare the solutions used in the IAA odor detection test in an area separate from where the test is performed, in order to prevent olfactory (smelling) fatigue in the employee.

(3) What are the odor threshold screening procedures?

(a) Conduct the screening test in a different room from the one used for actual fit testing. The two rooms must be well-ventilated to prevent the odor of IAA from becoming evident in the general room air where testing takes place.

(b) Type the following instructions on a card and place them on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(c) If the employee is unable to correctly identify the jar containing the odor test solution, do not perform the IAA qualitative fit test.

(d) If the employee correctly identifies the jar containing the odor test solution, the employee may proceed to respirator selection and fit testing.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07209, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07210 What are the isoamyl acetate fit testing procedures (QLFT)?

(1) The fit test chamber must be a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the employee's head. If no drum liner is available, construct a similar chamber using plastic sheeting.

(2) Attach a small hook to the inside top center of the chamber.

(3) Equip each respirator used for the fitting and fit testing with organic vapor cartridges or offer protection against organic vapors.

(4) After selecting, putting on, and properly adjusting a respirator, the employee must wear it to the fit testing room.

(5) This room used for fit testing must be separate from the room used for odor threshold screening and respirator selection. It must be well-ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(6) A copy of the test exercises and any prepared text from which the employee is to read must be taped to the inside of the test chamber.

(7) Upon entering the test chamber, give the employee a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 ml of pure IAA.

(8) Have the employee hang the wet towel on the hook at the top of the chamber. An IAA test swab or ampule may be substituted for the IAA wetted paper towel provided it has been demonstrated that the alternative IAA source will generate an IAA test atmosphere with a concentration equal to that generated by the paper towel method.

(9) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the employee; to explain the fit test, the importance of the employee's cooperation in the fit test, and the purpose for the test exercises; or to demonstrate some of the exercises.

(10) If at any time during the test, the employee detects the banana-like odor of IAA, the test is failed. The employee must quickly exit from the test chamber and leave the test area to avoid olfactory (smelling) fatigue.

(11) If the test is failed, the employee must return to the selection room and remove the respirator. The employee must:

- Repeat the odor sensitivity test;
- Select and put on another respirator;
- Return to the test area; and
- Again begin the fit test procedure described in subsections (1) through (8) of this section.

The process continues until a respirator that fits well has been found.

(12) Should the odor sensitivity test be failed, the employee must wait at least 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(13) If the employee passes the test, the efficiency of the test procedure must be demonstrated by having the employee break the respirator face seal and take a breath before exiting the chamber.

(14) When the employee leaves the chamber, the employee must remove the saturated towel and return it to the person conducting the test, so that there is no significant IAA concentration buildup in the chamber during subsequent tests.

(15) The used towels must be kept in a self-sealing plastic bag to keep the test area from being contaminated.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07211, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07212 Saccharin solution aerosol protocol (QLFT). The entire screening and testing procedure must be explained to the employee prior to conducting the screening test.
[Statutory Authority. RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07212, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07213 What are the taste threshold screening procedures for saccharin (QLFT)?

(1) Why use saccharin taste threshold screening?

The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the employee being tested can detect the taste of saccharin.

(2) What are the saccharin solution aerosol procedures?

(a) During threshold screening as well as during fit testing, the employee must wear an enclosure over the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts #FT 14 and #FT 15 combined, is adequate.

(b) The test enclosure must have a 3/4-inch (1.9 cm) hole in front of the employee's nose and mouth area to accommodate the nebulizer nozzle.

(c) Have the employee put on the test enclosure.

(d) Throughout the threshold screening test, the employee must breathe through a slightly open mouth with tongue extended.

(e) Instruct the employees to report when they detect a sweet taste.

(f) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, spray the threshold check solution into the enclosure. The nozzle is directed away from the nose and mouth of the person. This nebulizer must be clearly marked to distinguish it from the fit test solution nebulizer.

(g) Saccharin threshold check solution. Prepare the threshold check solution by dissolving 0.83 gram of sodium saccharin USP in 100 ml of warm water. It can be prepared by putting 1 ml of the fit test solution in 100 ml of distilled water.

(h) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(i) Ten squeezes are repeated rapidly and then the employee is asked whether the saccharin can be tasted. If the employee tastes a sweet taste during the ten squeezes, the screening test is completed. The taste threshold is noted as ten regardless of the number of squeezes actually completed.

(j) If the first response is negative, ten more squeezes are repeated rapidly and the employee is again asked whether the saccharin is tasted. If the employee tastes a sweet taste during the second ten squeezes, the screening test is completed. The taste threshold is noted as twenty regardless of the number of squeezes actually completed.

(k) If the second response is negative, ten more squeezes are repeated rapidly and the employee is again asked whether the saccharin is tasted. If the employee tastes a sweet taste during the third set of ten squeezes, the screening test is completed. The taste threshold is noted as thirty regardless of the number of squeezes actually completed.

(l) Note the number of squeezes required to solicit a taste response.

(m) If the saccharin is not tasted after 30 squeezes (step k), the employee is unable to taste saccharin and must not perform the saccharin fit test.

Note: If employees eat or drink something sweet before the screening test, they may be unable to taste the weak saccharin solution.

(n) If a taste response is elicited, ask the employee to take note of the taste for reference in the fit test.

(o) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(p) The nebulizer must be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07213, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07214 What is the saccharin solution aerosol fit testing procedure (QLFT)?

(1) The employee must not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in WAC 296-62-07210.

(3) Have the employee put on the enclosure while wearing the respirator selected in WAC 296-62-07202. The respirator must be properly adjusted and equipped with a particulate filter(s).

(4) Use a second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent to spray the fit test solution into the enclosure. Clearly mark this nebulizer to distinguish it from the screening test solution nebulizer.

(5) Prepare the fit test solution adding 83 grams of sodium saccharin to 100 ml of warm water.

(6) As before, the employees must breathe through a slightly open mouth with tongue extended, and report if they taste the sweet taste of saccharin.

(7) Insert the nebulizer into the hole in the front of the enclosure and spray an initial concentration of saccharin fit test solution into the enclosure.

(8) Use the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required to elicit a taste response as noted during the screening test. A minimum of 10 squeezes is required.

(9) After generating the aerosol, instruct the employee to perform the exercises in WAC 296-62-07202.

(10) Replenish the aerosol concentration every 30 seconds using one half the original number of squeezes used initially (for example, 5, 10 or 15).

(11) Instruct the employees to tell you if at any time during the fit test the taste of saccharin is detected. If the employee does not detect tasting the saccharin, the test is passed.

(12) If the taste of saccharin is detected, the fit is deemed unsatisfactory and the test is failed. A different respirator must be tried and the entire test procedure is repeated (taste threshold screening and fit testing).

(13) Since the nebulizer has a tendency to clog during use, periodically check the nebulizer to make sure that it is not clogged. If the nebulizer is clogged at the end of the test session, the test is invalid.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07214, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07217 Bitrex™ (denatonium benzoate) solution aerosol qualitative fit testing (QLFT) protocol. General information. The Bitrex™ (denatonium benzoate) solution aerosol QLFT protocol uses the published saccharin test protocol because that protocol is widely accepted. Bitrex™ is routinely used as a taste aversion agent in household liquids that children should not be drinking and is endorsed by the American Medical Association, the National Safety Council, and the American Association of Poison Control Centers. The entire screening and testing procedure must be explained to the employee prior to the conduct of the screening test.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07217, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07218 What is the taste threshold screening procedure for Bitrex™ (QLFT)?

(1) Why use odor threshold screening?

The Bitrex™ taste threshold screening, performed without wearing a respirator, is intended to determine whether the employee being tested can detect the taste of Bitrex™.

(2) What are the taste threshold screening procedures for Bitrex™ (QLFT)?

(a) During threshold screening as well as during fit testing, employees must wear an enclosure over the head and shoulders that is approximately 12 inches (30.5 cm) in diameter by 14 inches (35.6 cm) tall. The front portion of the enclosure must be clear from the respirator and allow free movement of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts #14 and #15 combined, is adequate.

(b) The test enclosure must have a 3/4-inch (1.9 cm) hole in front of the employee's nose and mouth area to accommodate the nebulizer nozzle.

(c) Have the employee put on the test enclosure.

(d) Throughout the threshold screening test, the employees must breathe through a slightly open mouth with tongue extended.

(e) Instruct the employees to tell you when they detect a bitter taste.

(f) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent, spray the threshold check solution into the enclosure. Clearly mark this nebulizer to distinguish it from the fit test solution nebulizer.

(g) Prepare the threshold check solution by adding 13.5 milligrams of Bitrex™ to 100 ml of 5% salt (NaCl) solution in distilled water.

(h) To produce the aerosol, the nebulizer bulb is firmly squeezed so that the bulb collapses completely, and is then released and allowed to fully expand.

(i) Rapidly repeat an initial ten squeezes and then ask the employee if the Bitrex™ can be tasted. If the employee reports tasting the bitter taste during the ten squeezes, the screening test is completed. Note the taste threshold as ten regardless of the number of squeezes actually completed.

(j) If the first response is negative, rapidly repeat ten more squeezes and ask the employee if the Bitrex™ is tasted. If the employee reports tasting the bitter taste during the second ten squeezes, the screening test is completed. Note the taste threshold as twenty regardless of the number of squeezes actually completed.

(k) If the second response is negative, rapidly repeat ten more squeezes and ask the employee if the Bitrex™ is tasted. If the employee reports tasting the bitter taste during the third set of ten squeezes, the screening test is completed. Note the taste threshold as thirty regardless of the number of squeezes actually completed.

(l) Note the number of squeezes required to solicit a taste response.

(m) If the Bitrex™ is not tasted after 30 squeezes (step k), the employee is unable to taste Bitrex™ and must not perform the Bitrex™ fit test.

(n) If a taste response is elicited, ask the employee to take note of the taste for reference in the fit test.

(o) Correct use of the nebulizer means that approximately 1 ml of liquid is used at a time in the nebulizer body.

(p) The nebulizer must be thoroughly rinsed in water, shaken to dry, and refilled at least each morning and afternoon or at least every four hours.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07218, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07219 What is the Bitrex™ solution aerosol fit testing procedure (QLFT)?

(1) The employee must not eat, drink (except plain water), smoke, or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure as that described in WAC 296-62-07210.

(3) Have the employee put on the enclosure while wearing the respirator selected according to WAC 296-62-07202. The respirator must be properly adjusted and equipped with any type particulate filter(s).

(4) Use a second DeVilbiss Model 40 Inhalation Medication Nebulizer or equivalent to spray the fit test solution into the enclosure. Clearly mark this nebulizer to distinguish it from the screening test solution nebulizer.

(5) Prepare the fit test solution by adding 337.5 mg of Bitrex™ to 200 ml of a 5% salt (NaCl) solution in warm water.

(6) As before, the employees must breathe through a slightly open mouth with tongue extended.

(7) Instruct the employees to tell you when they detect the bitter taste of Bitrex™.

(8) Insert the nebulizer into the hole in the front of the enclosure. Spray an initial concentration of the fit test solution into the enclosure. Use the same number of squeezes (either 10, 20 or 30 squeezes) based on the number of squeezes required for the employee to taste the bitter tastes as noted during the screening test.

(9) After generating the aerosol, instruct the employee to perform the exercises in WAC 296-62-07203.

(10) Replenish the aerosol concentration every 30 seconds using one half the number of squeezes used initially (for example, 5, 10 or 15).

(11) Have the employees tell you if at any time during the fit test they taste the bitter taste of Bitrex™. If the employee does not detect tasting the Bitrex™, the test is passed.

(12) If the taste of Bitrex™ is tasted, the fit is deemed unsatisfactory and the test is failed. A different respirator must be tried and the entire test procedures must be repeated (taste threshold screening and fit testing).

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07219, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07222 Irritant smoke (stannic chloride) protocol (QLFT). This qualitative fit test uses a person's response to the irritating chemicals released in the “smoke” produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07222, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07223 What are the general requirements and precautions for irritant smoke fit testing (QLFT)?

(1) The respirator to be tested must be equipped with high efficiency particulate air (HEPA) or P100 series filter(s).

(2) Use only stannic chloride smoke tubes for this protocol.

(3) Do not use any form of a test enclosure or hood.

(4) The smoke can be irritating to the eyes, lungs, and nasal passages. Take precautions to minimize the employee's exposure to irritant smoke. Sensitivity varies, and certain employees may respond to a greater degree to irritant smoke. Care must be taken when performing the sensitivity screening checks to use only the minimum amount of smoke necessary to elicit a response from the employee. Sensitivity screening checks determine whether the employee can detect the irritant smoke.

(5) The fit test must be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07223, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07224 What is the sensitivity screening check protocol for irritant smoke (QLFT)?

(1) Why use irritant smoke sensitivity screening checks?

Employees must be tested to see if they can detect a weak concentration of the irritant smoke.

(2) What are the sensitivity screening check procedures?

(a) Break both ends of a ventilation smoke tube containing stannic chloride, and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute, or an aspirator squeeze bulb.

(b) Cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.

(c) Advise the employees that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct them to keep their eyes closed while the test is performed.

(d) Allow the employee to smell a weak concentration of the irritant smoke before putting on a respirator to become familiar with its irritating properties and determine if they can detect the irritating properties of the smoke.

(e) Carefully direct a small amount of the irritant smoke toward the employees being tested to see if they can detect it.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07224, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07225 What is the irritant smoke fit testing procedure (QLFT)?

(1) Have the employee put on the respirator without assistance, and perform the required user seal check(s).

(2) Instruct the employees to keep their eyes closed.

(3) Direct the stream of irritant smoke from the smoke tube toward the face seal area of the employee, using the low flow pump or the squeeze bulb. Begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. Gradually make two more passes around the perimeter of the mask, moving to within six inches of the respirator.

(4) If the person being tested has not had an involuntary response and/or detected the irritant smoke, proceed with the test exercises.

(5) Have the employee perform the exercises required in WAC 296-62-07203 while the respirator seal is being continually challenged by the smoke. Direct the smoke around the perimeter of the respirator at a distance of six inches.

(6) If the employee being fit tested detects the irritant smoke at any time, the test is failed. An employee being retested must repeat the entire sensitivity check and fit test procedures.

(7) Have the employee remove the respirator.

(8) Give employees passing the irritant smoke test without evidence of a response (involuntary cough, irritation) a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test to determine if they still react to the smoke. The fit test is void if an employee does not respond to the smoke.

(9) If the employee responds to the second sensitivity check, then the fit test is passed.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07225, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07230 Appendix A-3: Quantitative Fit Testing (QNFT) Protocols for Respiratory Protection--Mandatory. This is a mandatory appendix to chapter 296-62 WAC, Part E, which includes WAC 296-62-07230 through 296-62-07248.

The following quantitative fit testing procedures are acceptable protocols:

- Nonhazardous test aerosol (such as corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS], or sodium chloride) generated in a test chamber, and employing instrumentation to quantify the fit of the respirator;
- Ambient aerosol as the test agent and appropriate instrumentation (condensation nuclei counter) to quantify the respirator fit;
- Controlled negative pressure and appropriate instrumentation to measure the volumetric leak rate of a facepiece to quantify the respirator fit.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10), § 296-62-07230, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07231 What are the general requirements for quantitative fit testing (QNFT)?

(1) You must make sure that persons administering QNFT are able to:

- Calibrate equipment and perform tests properly;
- Recognize invalid tests;
- Calculate fit factors properly; and
- Make sure that test equipment is in proper working order.

(2) You must make sure that QNFT equipment is kept clean, and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07231, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07233 Generated aerosol quantitative fit testing protocol (QNFT).

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07233, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07234 What equipment is required for generated aerosol fit testing (QNFT)?

(1) Instrumentation. Use aerosol generation, dilution, and measurement systems using particulates (corn oil, polyethylene glycol 400 [PEG 400], di-2-ethyl hexyl sebacate [DEHS] or sodium chloride) as test aerosols for quantitative fit testing.

(2) Test chamber.

(a) The test chamber must be large enough to permit all employees to perform freely all required exercises without disturbing the test agent concentration or the measurement apparatus.

(b) The test chamber must be equipped and constructed so that the test agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

(3) When testing air-purifying respirators, replace the normal filter or cartridge element with a high efficiency particulate air (HEPA) or P100 series filter supplied by the same manufacturer.

(4) Select the sampling instrument so that a computer record or strip chart record may be made of the test showing the rise and fall of the test agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers that integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(5) Do not expose the employee to any combination of substitute air-purifying elements, test agent and test agent concentration in excess of an established exposure limit for the test agent at any time during the testing process. Base the employee's exposure on the length of the exposure and the exposure limit duration.

(6) Construct the sampling port and place it on the test specimen respirator so that:

- No leaks occurs around the port (for example, where the respirator is probed);
- A free air flow is allowed into the sampling line at all times; and
- There is no interference with the fit or performance of the respirator.

The in-mask sampling device (probe) must be designed and used so that the air sample is drawn from the breathing zone of the employee, midway between the nose and mouth and with the probe extending into the facepiece cavity at least 1/4-inch.

(7) The person administering the fit test must be able to observe the employee inside the chamber during the test.

(8) The equipment generating the test atmosphere must maintain the concentration of test agent constant to within a 10 percent variation for the duration of the test.

(9) Keep the time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) to a minimum. You must be able to clearly see when an event occurs and when it is recorded on the strip chart or computer.

(10) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port must be:

- Equal in diameter;
- Made of the same material; and
- Equal in length.

(11) The exhaust flow from the test chamber must pass through an appropriate filter (i.e., high efficiency particulate filter) before release.

(12) When sodium chloride aerosol is used, the relative humidity inside the test chamber must not exceed 50 percent.

(13) Take into account the limitations of instrument detection when determining the fit factor.

(14) Test respirators must be maintained in proper working order and be inspected regularly for deficiencies such as cracks or missing valves and gaskets.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07234, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07235 What are the procedures for generated aerosol quantitative fit testing (QNFT)?

(1) When performing the initial user seal check using a positive or negative pressure check, crimp the sampling line in order to avoid air pressure leakage during either of these pressure checks.

(2) Using an abbreviated screening QLFT test is optional. You may use a QLFT screening test to quickly identify poor fitting respirators that passed the positive and/or negative pressure test and reduce the amount of QNFT time. Another option is to use the CNC QNFT instrument in the count mode to obtain a quick estimate of fit and eliminate poor fitting respirators before going on to perform a full QNFT.

(3) A reasonably stable test agent concentration must be measured in the test chamber prior to testing. For canopy or shower curtain types of test units, determine the test agent's stability after the employee has entered the test environment.

(4) Immediately after the employee enters the test chamber, measure the test agent concentration inside the respirator to make sure that the peak penetration does not exceed 5 percent for a half-mask or 1 percent for a full facepiece respirator.

(5) Obtain a stable test agent concentration prior to the actual start of testing.

(6) Do not over-tighten respirator restraining straps for testing. Have the employee adjust the straps, without assistance, to give a reasonably comfortable fit typical of normal use.

(7) Do not adjust the respirator once the fit test exercises begin.

(8) Stop the test whenever any single peak penetration exceeds 5 percent for half-masks and 1 percent for full facepiece respirators. The employee must be refitted and retested.

(9) Do not permit the employee to wear a half-mask or quarter facepiece respirator unless:

- A minimum fit factor of 100 is obtained; or
- A full facepiece respirator unless a minimum fit factor of 500 is obtained.

(10) Filters used for quantitative fit testing must be replaced whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07235, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07236 How are fit factors calculated (QNFT)?

(1) Determine the fit factor for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration measured inside the respirator for each test exercise except the grimace exercise.

(2) Calculate the average test chamber concentration using one of the following:

- Arithmetic average of the concentration measured before and after each test (i.e., 7 exercises); or
- Arithmetic average of the concentration measured before and after each exercise; or
- True average measured continuously during the respirator sample.

(3) Determine the concentration of the challenge agent inside the respirator by one of the following methods:

(a) Average peak penetration method. Average peak penetration method determines how much test agent penetrates into the respirator using a strip chart recorder, integrator, or computer. Determine the agent penetration averaging the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers that calculate the actual test agent penetration into the respirator for each exercise also will meet the requirements of the average peak penetration method.

(b) Maximum peak penetration. Maximum peak penetration method determines how much test agent penetrates into the respirator using a strip chart recordings of the test. The highest peak penetration for a given exercise represents the average penetration into the respirator for that exercise.

(c) Area under the peaks. Integrate the area under the individual peak for each exercise except the grimace exercise using computerized integration or other appropriate calculations.

(d) Overall fit factor. Calculate the overall fit factor using individual exercise fit factors.

- Convert the exercise fit factors to the penetration values.
- Determine the average.
- Then convert the average result back to a fit factor.

Use the following equation to calculate overall fit factor:

$$\text{Overall Fit Factor} = \frac{\text{Number of exercises}}{1/ff_1 .+ 1/ff_2 .+ 1/ff_3 .+ 1/ff_4 .+ 1/ff_5 .+ 1/ff_6 .+ 1/ff_7 .+ 1/ff_8}$$

Where ff_1, ff_2, ff_3, etc. are the fit factors for exercises 1, 2, 3, etc.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07236, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07238 Ambient aerosol condensation nuclei counter (CNC) quantitative fit testing protocol.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07238, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07239 General information about ambient aerosol condensation nuclei counter (CNC) protocol (QNFT).

(1) The ambient aerosol condensation nuclei counter (CNC) quantitative fit testing (Portacount™) protocol uses a probe to quantitatively fit tests respirators. A probed respirator has a special sampling device, installed on the respirator, that allows the probe to sample the air from inside the mask.

(2) The probed respirator is only used for quantitative fit tests.

(3) A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor.

(4) The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an employee's own respirator.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07239, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07240 What are the general requirements for ambient aerosol condensation nuclei counter (CNC) protocol (QNFT)?

(1) A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator.

(2) A minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator.

(3) The entire screening and testing procedure must be explained to the employee prior to the conduct of the screening test.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07240, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07242 What are the Portacount fit testing procedures?

(1) Check the respirator to make sure the:

- Sampling probe and line are properly attached to the facepiece; and
- Respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (for example, NIOSH 42 CFR 82 series 100, series 99, or series 95 particulate filter) per manufacturer's instruction.

(2) Instruct the employee to put on the respirator for five minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the employee to make certain the respirator is comfortable. Before fit testing, train the employee on how to wear the respirator properly.

(3) Check the following conditions for the adequacy of the respirator fit:

- Chin properly placed;
- Adequate strap tension, not overly tightened;
- Fit across nose bridge;
- Respirator of proper size to span distance from nose to chin;
- Tendency of the respirator to slip;
- Self-observation in a mirror to evaluate fit and respirator position.

(4) Have the employee do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting facepiece, try another size of the same model respirator, or another model of respirator.

(5) Follow the manufacturer's instructions for operating the Portacount and begin the test.

(6) Have the employee perform the exercises in WAC 296-62-07203.

(7) After the test exercises, ask the employee about comfort of the respirator. If the respirator is unacceptable, try another model of respirator.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07242, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07243 How is the Portacount test instrument used?

(1) The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The pass or fail message will indicate whether or not the test was successful. If the test was a pass, the fit test is over.

(2) Since the pass or fail criterion of the Portacount is user programmable, you must make sure that the pass or fail criterion meets the requirements for minimum respirator performance in WAC 296-62-07235.

(3) Keep a record of successful fit tests on file. The record must contain:

- The employee's name;
- Overall fit factor;
- Make, model, style, and size of respirator used; and
- Date tested.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07243, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07245 Controlled negative pressure (CNP) quantitative fit testing protocol (QNFT).

The CNP protocol provides an alternative to aerosol fit test methods.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07245, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07246 How does controlled negative pressure (CNP) fit testing work (QNFT)?

(1) The CNP fit test method technology is based on exhausting air from a temporarily sealed respirator facepiece to generate and then maintain a constant negative pressure inside the facepiece. The rate of air exhaust is controlled so that a constant negative pressure is maintained in the respirator during the fit test. The level of pressure is selected to replicate the mean inspiratory pressure that causes leakage into the respirator under normal use conditions. With pressure held constant, air flow out of the respirator is equal to air flow into the respirator. Therefore, measurement of the exhaust stream that is required to hold the pressure in the temporarily sealed respirator constant yields a direct measure of leakage air flow into the respirator.

(2) The CNP fit test method measures leak rates through the facepiece as a method for determining the facepiece fit for negative pressure respirators.

(3) Manufacturer attachments. The CNP instrument manufacturer Dynatech Nevada also provides attachments (sampling manifolds) that replace the filter cartridges to permit fit testing in an employee's own respirator.

(4) Performing the test. To perform the test, the employees close their mouths and hold their breath, after which an air pump removes air from the respirator facepiece at a preselected constant pressure.

(5) Facepiece fit. The facepiece fit is expressed as the leak rate through the facepiece, expressed as milliliters per minute.

(6) The quality and validity of the CNP fit tests are determined by the degree to which the in-mask pressure tracks the test pressure during the system measurement time of approximately five seconds. Instantaneous feedback in the form of a real-time pressure trace of the in-mask pressure is provided and used to determine test validity and quality.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07246, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07247 What are the controlled negative pressure (CNP) fit testing requirements and procedures (QNFT)?

(1) Fit factor.

- A minimum fit factor pass level of 100 is necessary for a half-mask respirator.
- A minimum fit factor of at least 500 is required for a full facepiece respirator.

(2) The entire screening and testing procedure must be explained to the employee prior to the conduct of the screening test.

(3) The instrument must have a nonadjustable test pressure of 15.0 mm water pressure.

(4) When performing fit tests, set the CNP system defaults at:

- 15 mm of water (-0.58 inches of water) test pressure and
- 53.8 liters per minute for the modeled inspiratory flow rate.

Note: CNP systems have built-in capability to conduct fit testing that is specific to unique work rate, mask, and gender situations that might apply in a specific workplace. Use of system default values, which were selected to represent respirator wear with medium cartridge resistance at a low-moderate work rate, will allow inter-test comparison of the respirator fit.

(5) The person conducting the CNP fit testing must be thoroughly trained to perform the test.

(6) Replace the respirator filter or cartridge with the CNP test manifold. Temporarily remove or prop open the inhalation valve downstream from the manifold.

(7) Train employees to hold their breath for at least 20 seconds.

(8) Have the employee put on the test respirator without any assistance from the individual who conducts the CNP fit test.

(9) The QNFT protocol must be followed according to WAC 296-62-07231 with an exception for the CNP test.

(10) The test instrument must have an effective audio warning device when the employee fails to hold his or her breath during the test.

(11) Stop the test whenever the employees fail to hold their breath. The employees must be refitted and retested.

(12) A record of the test must be kept on file, assuming the fit test was successful. The record must contain the employee's name; overall fit factor; make, model, style and size of respirator used; and date tested.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07247, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07248 What test exercises are required for controlled negative pressure (CNP) fit testing (QNFT)?

(1) Normal breathing. In a normal standing position, without talking, the employees must breathe normally for 1 minute. After the normal breathing exercise, the employees must hold their head straight ahead and hold their breath for 10 seconds during the test measurement.

(2) Deep breathing. In a normal standing position, the employees must breathe slowly and deeply for 1 minute, being careful not to hyperventilate. After the deep breathing exercise, the employees must hold their head straight ahead and hold their breath for 10 seconds during test measurement.

(3) Turning head side to side.

- Standing in place, the employees must slowly turn their heads from side to side between the extreme positions on each side for 1 minute, holding their heads each extreme momentarily so they can inhale at each side.

- After the turning head side to side exercise, have the employees hold their heads full left and hold their breath for 10 seconds during test measurement.
- Next, have the employees need to hold their head full right and hold their breath for 10 seconds during test measurement.

(4) Moving head up and down.

- Standing in place, the employees must slowly move their heads up and down for 1 minute.
- Instruct the employee to inhale in the up position (when looking toward the ceiling).
- After the moving head up and down exercise, the employees must hold their heads full up and hold their breath for 10 seconds during test measurement.
- Next, the employees must hold their heads full down and hold their breath for 10 seconds during test measurement.

(5) Talking. The employee must talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The employee can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song for 1 minute. After the talking exercise, the employee must hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(6) Grimace. The employee must grimace by smiling or frowning for 15 seconds.

(7) Bending over. Employees must bend at the waist as if they were touching their toes for 1 minute. Jogging in place must be substituted for this exercise in those test environments such as shroud-type QNFT units that prohibit bending at the waist. After the bending over exercise, the employees must hold their head straight ahead and hold their breath for 10 seconds during the test measurement.

(8) Normal Breathing.

- The employee must remove and put on the respirator again within a one-minute period.
- Then, in a normal standing position, without talking, the employee must breathe normally for 1 minute.
- After the normal breathing exercise, the employee must hold his or her head straight ahead and hold his or her breath for 10 seconds during the test measurement.

(9) After the test exercises, question the employee about the comfort of the respirator. If the respirator has become unacceptable, another model of a respirator must be tried.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07248, filed 05/04/99, effective 09/01/99.]

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WAC 296-62-07251 Appendix B-1: User Seal Check Procedures--Mandatory. This is a mandatory appendix to chapter 296-62 WAC, Part E.

The individual who uses a tight-fitting respirator must perform a user seal check to make sure that the respirator makes an adequate seal each time it is put on. Either the positive and negative pressure checks listed in this appendix, or the respirator manufacturer's recommended user seal check method must be used. User seal checks are not substitutes for qualitative or quantitative fit tests.

(1) Facepiece positive and/or negative pressure checks.

(a) Positive pressure check. Close off the exhalation valve and exhale gently into the facepiece. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve. The face fit is considered adequate if a slight positive pressure (inflation) can be built up inside the facepiece without any evidence of outward leakage of air at the seal. Carefully replace the exhalation valve cover, if it was removed, after the test.

(b) Negative pressure check. Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. If the design of the inlet opening of the cartridges cannot be effectively covered with the palm of the hand, cover the inlet opening of the cartridge with a thin latex or nitrile glove. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

(2) Manufacturer's recommended user seal check procedures. The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures describe above provided that you demonstrate that the manufacturer's procedures are equally effective.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07251, filed 05/04/99, effective 09/01/99.]

Spanish version

WAC 296-62-07251: Apéndice B-1, (Obligatorio) Procedimiento del Usuario para la Prueba de Ajuste.

Este es un apéndice obligatorio del capítulo 296-62 WAC, Part E.

El individuo que utiliza un respirador ajustado debe realizar una prueba de ajuste para cerciorarse de que el respirador esté adecuadamente ajustado cada vez que se lo pone. Bien la prueba de presión positiva y negativa mencionada en este apéndice, o el método de ajuste recomendado por el fabricante del respirador debe ser utilizado. Las pruebas de ajuste del usuario no son substitutas para las pruebas cualitativas o cuantitativas de adaptación.

(1) Pruebas Positivas y/o Negativas del Respirador

(a) Pruebas de presión positivas. Ciérre la válvula de exhalación y exhale suavemente en el respirador. Para la mayoría de los respiradores, el método de prueba de escape de aire requiere que primero se quite la cubierta de la válvula de exhalación antes de cerrarla. El ajuste del respirador se considera adecuado si una presión positiva leve (inflación) se puede acumular dentro del respirador sin ninguna evidencia de salida de aire al exterior en el sello del respirador . Después de la prueba, cuidadosamente reinstale la cubierta de la válvula de la exhalación, si es que fue quitada.

(b) Pruebas de presión negativas. Cierre la apertura de entrada del cartucho cubriendolo con la palma de la mano o instalando las tapaderas del filtro, inhale suavemente de modo que el respirador se pliege levemente, y contenga la respiración por diez segundos. Si el diseño de la apertura de entrada de los cartuchos no se puede cubrir con eficacia con la palma de la mano, cubra la apertura de la entrada del cartucho con un guante fino de látex o de nitrile. Si el respirador permanece en su condición levemente plegada y no se detecta ninguna entrada de aire, la tensión del respirador se considera satisfactoria.

(2) Procedimientos de ajuste para el usuario recomendados por fabricante. Los procedimientos recomendados por el fabricante del respirador para realizar las pruebas de sellamiento del usuario se pueden utilizar en vez de las pruebas positivas y/o negativas descritas anteriormente siempre y cuando usted pueda demostrar que los procedimientos del fabricante son igualmente eficaces.

WAC 296-62-07253 Appendix B-2: Respirator Cleaning Procedures--Mandatory. This is a mandatory appendix to chapter 296-62 WAC, Part E.

(1) These procedures are provided for you to use when cleaning respirators. They are general in nature, and as an alternative you may use the cleaning recommendations provided by the manufacturer of the respirators used by your employees, if the manufacturer's procedures are as effective as those listed here in Appendix B-2. Procedures are as effective when they meet the requirements in Appendix B-2, i.e., that must make sure that the respirator is properly cleaned and disinfected so that the respirator is not damaged and does no harm to the user.

(2) Procedures for cleaning respirators.

(a) Remove filters, cartridges, or canisters. Remove speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

(b) Wash components in warm (43°C [110°F] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

(c) Rinse components thoroughly in clean, warm (43°C [110°F] maximum), preferably running water. Drain.

(d) When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for two minutes in one of the following:

(i) Hypochlorite solution (50 ppm of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 43°C (110°F); or,

(ii) Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45% alcohol) to one liter of water at 43°C (110°F); or,

(iii) Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

(e) Rinse components thoroughly in clean, warm (43°C [110°F] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

(f) Components should be hand-dried with a clean lint-free cloth or air-dried.

(g) Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

(h) Test the respirator to make sure that all components work properly.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07253, filed 05/04/99, effective 09/01/99.]

Spanish version

WAC 296-62-07253: Apéndice B-2 (Obligatorio) Procedimientos De Limpieza Del Respirador.

Este es un apéndice obligatorio del capítulo 296-62 WAC, Parte E.

(1) Estos procedimientos son proporcionados para que usted los use cuando esté limpiando los respiradores. Los procedimientos son generales en naturaleza, y como una alternativa utilizar las recomendaciones de limpieza proporcionadas por el fabricante de los respiradores usados por sus empleados, si es que los procedimientos del fabricante son tan eficaces como ésos enumerados aquí en el apéndice B-2. Procedimientos son tan eficazes cuando son iguales a los requisitos en el apéndice B-2, es decir, que debe cerciorarse de que el respirador haya sido limpiado y desinfectado correctamente para que no sea dañado y no dañe al usuario.

(2) Procedimientos Para Limpiar Respiradores

(a) Quite los filtros, los cartuchos, o los filtros de bote. Quite los diafragmas , la válvula de presión y demanda, mangueras, o cualquier otro componente recomendado por el fabricante. Deseche o repare cualquier pieza defectuosa.

(b) Lave los componentes en agua tibia (43 grados C [110 grados F]) y con un detergente suave o con un limpiador recomendado por el fabricante. Un cepillo tieso de la cerda (no alambre) se puede utilizar para facilitar remover de la suciedad.

(c) Enjuague los componentes a fondo en agua limpia y tibia (43 grados C [110 grados F]), preferiblemente con agua corriente. Saquelos del agua.

(d) Cuando el limpiador usado no contiene desinfectante, los componentes del respirador se deben sumergirse por dos minutos en uno del siguiente desinfectantes:

(i) Solución del hipoclorito (50 PPM de cloro) hecha agregando aproximadamente un mililitro de cloro limpiaropa a un litro de agua a 43 grados C (110 grados F); o,

(ii) Solución acuosa del yodo (50 PPM de yodo) hecha agregando aproximadamente 0.8 mililitros de tinte de yodo (6-8 gramos de amonia y/o yoduro de potasio /100 cc del alcohol 45%) a un litro de agua a 43 grados C (110 grados F); o,

(iii) Otros productos para la limpieza comerciales de calidad desinfectante equivalente cuando se utilizan según las instrucciones, si su uso es recomendado o aprobado por el fabricante del respirador.

(e) Enjuague los componentes a fondo en agua limpia, y tibia (43 grados C [110 grados F]), preferiblemente con agua corriente. Saquelos del agua. Es muy importante enjuagar cuidadosamente los componentes. Los detergentes o los desinfectantes que se secan en los respiradores pueden causar dermatitis. Además, algunos desinfectantes, si no se remueven totalmente, pueden causar deterioración del plastico, o corroer las piezas de metal.

(f) Los componentes deben de secarse a mano con un trapo sin pelusa o ser secados con aire.

(g) Reasamble el repirador, cambie los filtros, los cartuchos, y los filtors de bote cuando sea necesario.

(h) Pruebe el respirador para cerciorarse de que todos los componentes trabajan correctamente.

WAC 296-62-07255 Appendix C: WISHA Respirator Medical Evaluation Questionnaire--Mandatory.
This is a mandatory appendix to chapter 296-62 WAC, Part E.

To the employer:
You must not review employee questionnaires.

To the employer's PLHCP:
Answers to questions in Section 1 and question 9 in Section 2 of Part A do not require further medical evaluations.

To the employee:
Your employer must allow you to answer this questionnaire during normal working hours, or at a time and place that is convenient to you. To maintain your confidentiality, your employer or supervisor must not look at or review your answers, and your employer must tell you how to deliver or send this questionnaire to the health care professional who will review it.

Part A. Section 1. Mandatory

The following information must be provided by every employee who has been selected to use any type of respirator (please print).

1. Today's date:_____ 2. Your name:_____

3. Your age (to nearest year):_____ 4. Sex (circle one): Male / Female

5. Your height:_____ft._____in. 6. Your weight:_____lbs.

7. Your job title:_____

8. A phone number where you can be reached by the health care professional who reviews this questionnaire (include the Area Code):_____

9. The best time to telephone you at this number:_____

10. Has your employer told you how to contact the health care professional who will review this questionnaire (circle one): Yes / No

11. Check the type of respirator you will use (you can check more than one category):

a._____N, R, or P filtering facepiece respirator (dust mask style, half facepiece respirators without cartridges).

b._____Check all that apply.

☐ Half mask ☐ Full facepiece mask ☐ Helmet hood ☐ Escape

☐ Non-powered cartridge or canister ☐ Powered air-purifying cartridge respirator (PAPR)

☐ Supplied-air or Air-line

Self contained breathing apparatus (SCBA): ☐ Demand or ☐ Pressure demand

Other:_____

12. Have you worn a respirator (circle one): Yes / No

If "yes," what type(s):_____

_____

Part A. Section 2. Mandatory

Questions 1 through 9 below must be answered by every employee who has been selected to use any type of respirator (please circle "yes" or "no").

1. Do you *currently* smoke tobacco, or have you smoked tobacco in the last month: Yes / No

2. Have you *ever had* any of the following conditions?

a.	Seizures (fits):	Yes /	No
b.	Diabetes (sugar disease):	Yes /	No
c.	Allergic reactions that interfere with your breathing:	Yes /	No
d.	Claustrophobia (fear of closed-in places):	Yes /	No
e.	Trouble smelling odors:	Yes /	No

3. Have you *ever had* any of the following pulmonary or lung problems?

a.	Asbestosis:	Yes /	No
b.	Asthma:	Yes /	No
c.	Chronic bronchitis:	Yes /	No
d.	Emphysema:	Yes /	No
e.	Pneumonia:	Yes /	No
f.	Tuberculosis:	Yes /	No
g.	Silicosis:	Yes /	No
h.	Pneumothorax (collapsed lung):	Yes /	No
i.	Lung cancer:	Yes /	No
j.	Broken ribs:	Yes /	No
k.	Any chest injuries or surgeries:	Yes /	No
l.	Any other lung problem that you've been told about:	Yes /	No

4. Do you *currently* have any of the following symptoms of pulmonary or lung illness?

a.	Shortness of breath:	Yes /	No
b.	Shortness of breath when walking fast on level ground or walking up a slight hill or incline:	Yes /	No
c.	Shortness of breath when walking with other people at an ordinary pace on level ground:	Yes /	No
d.	Have to stop for breath when walking at your own pace on level ground:	Yes /	No
e.	Shortness of breath when washing or dressing yourself:	Yes /	No
f.	Shortness of breath that interferes with your job:	Yes /	No
g.	Coughing that produces phlegm (thick sputum):	Yes /	No
h.	Coughing that wakes you early in the morning:	Yes /	No
i.	Coughing that occurs mostly when you are lying down:	Yes /	No
j.	Coughing up blood in the last month:	Yes /	No
k.	Wheezing:	Yes /	No
l.	Wheezing that interferes with your job:	Yes /	No
m.	Chest pain when you breathe deeply:	Yes /	No
n.	Any other symptoms that you think may be related to lung problems:	Yes /	No

Part A. Section 2. Mandatory (Cont.)

5. Have you *ever had* any of the following cardiovascular or heart problems?

a.	Heart attack:	Yes	/	No
b.	Stroke:	Yes	/	No
c.	Angina:	Yes	/	No
d.	Heart failure:	Yes	/	No
e.	Swelling in your legs or feet (not caused by walking):	Yes	/	No
f.	Heart arrhythmia (heart beating irregularly):	Yes	/	No
g.	High blood pressure:	Yes	/	No
h.	Any other heart problem that you've been told about:	Yes	/	No

6. Have you *ever had* any of the following cardiovascular or heart symptoms?

a.	Frequent pain or tightness in your chest:	Yes	/	No
b.	Pain or tightness in your chest during physical activity:	Yes	/	No
c.	Pain or tightness in your chest that interferes with your job:	Yes	/	No
d.	In the past two years, have you noticed your heart skipping or missing a beat:	Yes	/	No
e.	Heartburn or indigestion that is not related to eating:	Yes	/	No
f.	Any other symptoms that you think may be related to heart or circulation problems:	Yes	/	No

7. Do you *currently* take medication for any of the following problems?

a.	Breathing or lung problems:	Yes	/	No
b.	Heart trouble:	Yes	/	No
c.	Blood pressure:	Yes	/	No
d.	Seizures (fits):	Yes	/	No

8. If you've used a respirator, have you *ever had* any of the following problems? (If you've never used a respirator, check the following space and go to question 9:)

a.	Eye irritation:	Yes	/	No
b.	Skin allergies or rashes:	Yes	/	No
c.	Anxiety:	Yes	/	No
d.	General weakness or fatigue:	Yes	/	No
e.	Any other problem that interferes with your use of a respirator:	Yes	/	No

9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire: Yes / No

Part A. Section 3. Mandatory for SCBA or Full Facepiece Respirator Users

Questions 10 to 15 below must be answered by every employee who has been selected to use either a full-facepiece respirator or a self-contained breathing apparatus (SCBA). For employees who have been selected to use other types of respirators, answering these questions is voluntary.

10. Have you *ever lost* vision in either eye (temporarily or permanently): Yes / No

11. Do you *currently* have any of the following vision problems?

a.	Wear contact lenses:	Yes / No
b.	Wear glasses:	Yes / No
c.	Color blind:	Yes / No
d.	Any other eye or vision problem:	Yes / No

12. Have you *ever had* an injury to your ears, including a broken ear drum: Yes / No

13. Do you *currently* have any of the following hearing problems?

a.	Difficulty hearing:	Yes / No
b.	Wear a hearing aid:	Yes / No
c.	Any other hearing or ear problem:	Yes / No

14. Have you *ever had* a back injury: Yes / No

15. Do you *currently* have any of the following musculoskeletal problems?

a.	Weakness in any of your arms, hands, legs, or feet:	Yes / No
b.	Back pain:	Yes / No
c.	Difficulty fully moving your arms and legs:	Yes / No
d.	Pain or stiffness when you lean forward or backward at the waist:	Yes / No
e.	Difficulty fully moving your head up or down:	Yes / No
f.	Difficulty fully moving your head side to side:	Yes / No
g.	Difficulty bending at your knees:	Yes / No
h.	Difficulty squatting to the ground:	Yes / No
i.	Climbing a flight of stairs or a ladder carrying more than 25 lbs:	Yes / No
j.	Any other muscle or skeletal problem that interferes with using a respirator:	Yes / No

Part B: PLHCP Discretionary Questions

If appropriate to specific job requirements or conditions, additional questions -- including but not limited to the following -- may be added at the discretion of the health care professional to clarify an employee's ability to use a respirator.

1. In your present job, are you working at high altitudes (over 5,000 feet) or in a place that has lower than normal amounts of oxygen: Yes / No
   If "yes," do you have feelings of dizziness, shortness of breath, pounding in your chest, or other symptoms when you're working under these conditions: Yes / No
2. At work or at home, have you ever been exposed to hazardous solvents, hazardous airborne chemicals (for example, gases, fumes, or dust), or have you come into skin contact with hazardous chemicals: Yes / No
   If "yes," name the chemicals if you know them:
3. Have you ever worked with any of the materials, or under any of the conditions, listed below:
   a. Asbestos: Yes / No
   b. Silica (for example, in sandblasting): Yes / No
   c. Tungsten/cobalt (for example, grinding or welding this material): Yes / No
   d. Beryllium: Yes / No
   e. Aluminum: Yes / No
   f. Coal (for example, mining): Yes / No
   g. Iron: Yes / No
   h. Tin: Yes / No
   i. Dusty environments: Yes / No
   j. Any other hazardous exposures: Yes / No
      If "yes," describe these exposures:
4. List any second jobs or side businesses you have:
5. List your previous occupations:
6. List your current and previous hobbies:
7. Have you been in the military services? Yes / No
   If "yes," were you exposed to biological or chemical agents (either in training or combat): Yes / No
8. Have you ever worked on a HAZMAT team? Yes / No
9. Other than medications for breathing and lung problems, heart trouble, blood pressure, and seizures mentioned earlier in this questionnaire, are you taking any other medications for any reason (including over-the-counter medications): Yes / No
   If "yes," name the medications if you know them:
10. Will you be using any of the following items with your respirator(s)?
    a. HEPA Filters: Yes / No
    b. Canisters (for example, gas masks): Yes / No
    c. Cartridges: Yes / No
11. How often are you expected to use the respirator(s) (circle "yes" or "no" for all answers that apply to you)?:
    a. Escape only (no rescue): Yes / No
    b. Emergency rescue only: Yes / No
    c. Less than 5 hours *per week:* Yes / No
    d. Less than 2 hours *per day:* Yes / No
    e. 2 to 4 hours per day: Yes / No
    f. Over 4 hours per day: Yes /No

Part B: PLHCP Discretionary Questions (cont.)

12. During the period you are using the respirator(s), is your work effort:

    a. *Light* (less than 200 kcal per hour): Yes / No
    If "yes," how long does this period last during the average shift:_____hrs._____mins.
    Examples of a light work effort are sitting while writing, typing, drafting, or performing light assembly work; or standing while operating a drill press (1-3 lbs.) or controlling machines.

    b. Moderate (200 to 350 kcal per hour): Yes / No
    If "yes," how long does this period last during the average shift:_____hrs._____mins.
    Examples of moderate work effort are sitting while nailing or filing; driving a truck or bus in urban traffic; standing while drilling, nailing, performing assembly work, or transferring a moderate load (about 35 lbs.) at trunk level; walking on a level surface about 2 mph or down a 5-degree grade about 3 mph; or pushing a wheelbarrow with a heavy load (about 100 lbs.) on a level surface.

    c. *Heavy* (above 350 kcal per hour): Yes / No
    If "yes," how long does this period last during the average shift:_____hrs._____mins.
    Examples of heavy work are lifting a heavy load (about 50 lbs.) from the floor to your waist or shoulder; working on a loading dock; shoveling; standing while bricklaying or chipping castings; walking up an 8-degree grade about 2 mph; climbing stairs with a heavy load (about 50 lbs.)

13. Will you be wearing protective clothing and/or equipment (other than the respirator) when you're using your respirator: Yes / No If "yes," describe this protective clothing and/or equipment:

14. Will you be working under hot conditions (temperature exceeding 77 deg.F): Yes / No

15. Will you be working under humid conditions: Yes / No

16. Describe the work you'll be doing while you're using your respirator(s):

17. Describe any special or hazardous conditions you might encounter when you're using your respirator(s) (for example, confined spaces, life-threatening gases):

18. Provide the following information, if you know it, for each toxic substance that you'll be exposed to when you're using your respirator(s):
    Name of the first toxic substance:
    Estimated maximum exposure level per shift:
    Duration of exposure per shift:

    Name of the second toxic substance:
    Estimated maximum exposure level per shift:
    Duration of exposure per shift:

    Name of the third toxic substance:
    Estimated maximum exposure level per shift:
    Duration of exposure per shift:

    The name of any other toxic substances that you'll be exposed to while using your respirator:

19. Describe any special responsibilities you'll have while using your respirator(s) that may affect the safety and well-being of others (for example, rescue, security):

[Statutory Authority: RCW 49.17.010, .040, .050. 00-21-100 (Order 00-06), § 296-62-07255, filed 10/18/00, effective 01/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07255, filed 05/04/99, effective 09/01/99.]

Spanish version

WAC 296-62-07255 Apéndice C (Obligatorio) Cuestionario de evaluacion Medica requerido por WISHA para el uso de respiradores. Esto es un apéndice obligatorio dell capítulo 296-62 WAC, part E.

Para el patrón:
Usted no debe revisar los cuestionarios del empleado.

Para profesional de salud:
Las respuestas a las preguntas en la sección 1 y la pregunta 9 de la sección 2 de la parte A no requieren otras evaluaciones médicas.

Para el empleado:
Su patrón debe permitir que usted conteste a este cuestionario durante horas de trabajo o en un lugar que sea conveniente para usted. Para mantener este cuestionario confidencial, su patrón o supervisor no debe ver o revisar sus respuestas y su patrón debe decirle cómo entregar o enviar este cuestionario al profesional de salud con licencia autorizado por el estado.

Parte A. Sección 1. Obligatorio

La información siguiente se debe proporcionar por todos los empleados que han sido seleccionados utilizar cualquier tipo de respirador (por favor use letra de molde).

1. Fecha:_____ 2. Nombre:_____
3. Edad:_____ 4. Sexo. (círcule uno): Hombre / Mujer
5. Cuanto mide?:_____ pies _____ pulgadas. 6. Cuanto pesa?:_____ libras.
7. Título o tipo de trabajo: _____
8. Número de teléfono donde pueda comunicarse el profesional de salud que haya revisado su cuestionario (incluya el area): _____
9. La mejor hora para llamarle a este número:_____
10. Le a dicho su patrón como ponerse en contacto con el profesional de salud que revisará este cuestionario (círcule uno): Si / No
11. Anote el tipo de respirador que va a utilizar (puede anotar más de una categoría):
    a. _____ Respirador disponible de R, N o P (máscarilla contra el polvo, respiradores sin los cartuchos).
    b. _____ Anote todo lo que use.
    - ☐ Respirador de media careta ☐ Respirador de careta completa ☐ Respirador de casco
    - ☐ Respirador de escape ☐ Respirador no electrico de cartuchos o de bote
    - ☐ Respirador con manguera con soplador ☐ Respirador con linea de aire
    - ☐ Mascarilla disponible (ejemplo N-95)
    - ☐ Aparato repiratorio autonomo: ☐ en demanda o ☐ demanda de pressión
    - Otro:_____
12. Ha usado algun tipo de respirador (círcule uno): Si / No
    Si es que si, que tipo? _____
    _____

Parte A. Sección 2. Obligatorio

Las preguntas del 1 al 9 se deben de contestar por cada empleado que fue seleccionado para usar cualquier tipo de respirador (Marque con un circulo para indicar sus respuestas).

1. Corrientemente, fuma tabaco o ha fumado durante el mes pasado? Si / No

2. Ha tenido algunas de las las siguientes condiciones medicas?

   a. Covulsiones: Si / No
   b. Diabetes (azúcar en la sangre): Si / No
   c. Reacciones alérgicas que interfieren con su respiración: Si / No
   d. Claustrofobia (miedo de estar en epacios cerrados): Si / No
   e. Dificultad de oler: Si / No

3. Ha tenido alguno de los siguientes problemas pulmonares o problemas del pulmón?

   a. Asbestosis: Si / No
   b. Asma: Si / No
   c. Bronquitis crónica: Si / No
   d. Enfisema: Si / No
   e. Pulmonía: Si / No
   f. Tuberculosis: Si / No
   g. Silicosis: Si / No
   h. Neumotorax (pulmón colapsado): Si / No
   i. Cáncer del pulmón: Si / No
   j. Costillas rotas: Si / No
   k. Lesiones o cirugías en el pecho: Si / No
   l. Cualquier otro problemas pulmónares: Si / No

4. Actualmente, tiene usted algunos de los síntomas siguientes de enfermedades pulmonares o problems del pulmon?

   a. Repiración dificultosa: Si / No
   b. Respiración dificultosa al caminar rápidamente en lugares planos o al caminar en una colina o una pendiente leve: Si / No
   c. Respiración dificultosa al caminar con gente en un paso ordinario en lugares planos: Si / No
   d. Tiene que pararse a respirar al caminar en su propio paso en lugares planos: Si / No
   e. Problemas de respiración al bañarse o al vestirse: Si / No
   f. Respiración dificultosa que interfiere con su trabajo: Si / No
   g. Tos que produce flema (esputo grueso): Si / No
   h. Tos que lo despierta temprano en la mañana: Si / No
   i. Tos que ocurre generalmente cuando está acostado: Si / No
   j. Tos con sangre en el mes pasado: Si / No
   k. Respiración jadeante: Si / No
   l. Repiración jadeante que interfiere con su trabajo: Si / No
   m. Dolor en el pecho cuando respira profundamente: Si / No
   n. Cualquier otro síntoma que usted piense se relacione a problemas del pulmón: Si / No

(Continuación) Parte A. Sección 2. Obligatorio

5. Ha tenido en el pasado cualquiera de los siguientes problemas cardiovasculares o del corazón ?

a.	Ataque del corazón:	Si	/	No
b.	Ataque cerebrovascular:	Si	/	No
c.	Angina de pecho:	Si	/	No
d.	Paro cardíaco:	Si	/	No
e.	Hinchazón del de los pies o piernas (no causada por caminar):	Si	/	No
f.	Arritmia del corazón:	Si	/	No
g.	Alta presión:	Si	/	No
h.	Cualquier otro problema del corazón que usted sepa?:	Si	/	No

6. Ha tenido en el pasado cualquiera de los siguientes síntomas cardiovasculares o del corazón ?

a.	Dolor en el pecho o pecho apretado? :	Si	/	No
b.	Dolor en el pecho o pecho apretado durante actividad física:	Si	/	No
c.	Dolor en el pecho o pecho apretado que lo lo deja trabajar normalmente:	Si	/	No
d.	En los últimos dos años, ha notado que el corazón le salta, que falla un látido:	Si	/	No
e.	Acedías o indigestion o que no se relacionen con la comida:	Si	/	No
f.	Cualquier otro síntoma que usted piense puede ser causado por los problemas del corazón o de la circulación de la sangre?:	Si	/	No

7. Está tomado medicina para alguno de los siguientes problemas ?

a.	Problemas de la respiración o del pulmón:	Si	/	No
b.	Problemas del corazón:	Si	/	No
c.	Alta presión:	Si	/	No
d.	Convulsiones:	Si	/	No

8. Si ha usado un respirador, ha tenido algunos de los siguientes problemas ? (si usted nunca ha usado un respirador, pase a la pregunta 9.)

a.	Irritación en los ojos:	Si	/	No
b.	Alergias o erupciones de la piel:	Si	/	No
c.	Ansiedad:	Si	/	No
d.	Debilidad general o fatiga desacostumbrada:	Si	/	No
e.	Cualquier otro problema que interfiera con el uso de un respirador:	Si	/	No

9. Le gustaría hablar sobre las respuestas con el profesional de salud que revisará este cuestionario? Si / No

Parte A. Section 3. (Obligatorio) Para usuarios de aparato respiratorio autonomo (SCBA) o respiradores de careta completa

Las preguntas del 10 al 15 deben ser contestadas por los empleado seleccionados para usar un respirador de careta completa o un aparato respiratorio autónomo (SCBA). Los empleados que usan otro tipo de respiradores no tienen que contestar estas preguntas.

10. Ha perdido la vista en cualquier ojo (temporalmente o permanentemente): Si / No

11. En la actualidad, tiene cualesquiera de los problemas siguientes con la vista?

    a. Usa lentes de contacto: Si / No
    b. Usa lentes: Si / No
    c. Daltonismo (dificultd de distinguir colores): Si / No
    d. Tiene problemas con los ojos o la vista?: Si / No

12. Ha sufrido una lesión en los oídos, incluyendo rotura del tímpano ?: Si / No

13. Actualmente, tiene algunos de los siguientes problemas para oir?:

    a. Dificultad para oir: Si / No
    b. Usa un aparato para oir: Si / No
    c. Tiene algun otro problema en los oidos o dificultad de escuchar?: Si / No

14. Se ha dañado o lastimado la espalda?: Si / No

15. Tiene en la actualidad uno de los siguientes problemas musculoesqueletales?

    a. Debilidad en los brazos, manos, piernas, o pies: Si / No
    b. Dolor de espalda : Si / No
    c. Dificultad para movere completamente los brazos y las piernas: Si / No
    d. Dolor o engarrotamiento cuando se inclina para adelante o para atras: Si / No
    e. Dificultad patra mover la cabeza completamente arriba opara abajo: Si / No
    f. Dificultad para mover la cabeza a los lados: Si / No
    g. Dificultad para agacharse doblando las rodillas: Si / No
    h. Dificultad para agacharse hast tocar el piso: Si / No
    i. Dificultad de subir una escalera cargando mas de 25 libras: Si / No
    j. Algun otro problema múscular o esquelétal que interfiera con el uso del respirador: Si / No

Parte B – Preguntas Discrecionales

Si es apropiado para las condiciones o requerimientos especificos de un trabajo, preguntas adicionales – incluyendo, pero no limitadas a las siguientes , pueden ser agregadas al cuestionario a discrecion del profesional de salud.

1. En el presente trabajo, ha trabajado en alturas altas (arriba de 5,000 pies) o en sitios que tienen menos oxigeno de lo normal?: Si/No
   Si la respuesta es “Si”, se ha sentido mareado, o ha tenido dificultad para respirar, palpitaciones, o cualquier otro síntoma que usted no tiene cuando no esta trabajando bajo estas condiciones: Si/No

2. En el trabajo o en su casa, ha estado expuesto a solventes o contaminantes peligrosos en el aire (por ejemplo, gases, humos, o polvos) o ha tenido contacto de la piel con quimicos peligrosos?: Si/No
   Escriba las quimicas y productos con las que ha estado expuesto, si sabe cuales son:

3. Ha trabajado con los siguientes materiales o las condiciones anotadas abajo?:
   a. Asbestos: Si/No
   b. Silice (Limpiar mediante un chorro de arena): Si/No
   c. Tungsteno/Cobalto (pulverizar o soldadura): Si/No
   d. Berilio: Si/No
   e. Aluminio: Si/No
   f. Carbon de piedra (minando): Si/No
   g. Hierro: Si/No
   h. Estaño: Si/No
   i. Ambiente polvoriento: Si/No
   j. Otra exposicion peligrosa: Si/No
      Si es que si, describa las exposiciones peligrosas:

4. Anote otros trabajos o un negocio secundarios, (aparte de este) que usted tenga:

5. Apunte sus trabajos previos:

6. Apunte sus pasatiempos previos:

7. Ha ido al servicio militar?: Si/No

Si la respuesta es si, ha estado expuesto a agentes quimicos o biologicos durante entrenamiento o combate?: Si/No

8. Ha trabajado usted en un equipo de HAZMAT?: Si/No

9. Esta tomando alguna medicina que no haya mencionado en este cuestionario (incluyendo remedios caseros o medicinas que compra sin receta)?: Si/No
   Si la respuesta es “Si”, cuales son?

10. Va usted a usar algunas de las siguientes partes con su respirator?: Si/No
    a. Filtros HEPA: Si/No
    b. Filtros de bote (por ejemplo, caretas antigás): Si/No
    c. Cartuchos : Si/No

11. Cuantas veces espera usar el respirador? (círcule " sí " o " no " en las respuestas que se aplican a usted)?
    a. Escape solamente (no rescate): Si/No
    b. Rescate de emergencia solamente: Si/No
    c. Menos de 5 horas por semana: Si/No
    d. Menos de 2 horas por día: Si/No
    e. 2 a 4 horas por día: Si/No
    f. Mas de 4 horas por día: Si/No

(Continuación) Parte B – Preguntas Discrecionales

12. Durante el período que usa el respirador, el esfuerzo del trabajo es:
    a. Ligero (menos de 200 kcal por hora): Si/No
    Si es que sí, cuánto tiempo dura este período durante el turno?: _____hrs. _____min.
    Ejemplos de trabajos ligeros son: estár sentando escribiendo, escribiendo a máquina, trabajando la línea de montaje, realizando trabajo de asambleo ligero; o estando parado mientras que opera un taladro (1-3 libras.) o controlando máquinas .

    b. Moderado (200 a 350 kcal por hora): Si/No
    Si es que sí cuánto tiempo dura este período durante el turno?: _____hrs. _____min.
    Ejemplos de trabajos moderados son: estár sentado clavando o el archivando; conducir un camion o un autobús en tráfico urbano; estar parado mientras que perfora, clava, asamblando, o transfiriendo una carga moderada (como de 35 libras) al nivel de la cintura; el caminar en una superficie plana a 2 mph o bajando a 3 millas por hora; o empujando una carretilla con una carga pesada (cerca de 100 libras.) en una superficie plana.

    c. Pesado (sobre 350 kcal por hora): Si/No
    Si es que sí, Si es que sí cuánto tiempo dura este período durante el turno?: _____hrs. _____min.
    Ejemplos de trabajos pesados: levantando cargas pesadas (cerca de 50 libras.) del piso a la altura de la cintura u hombros; trabajando cargando o descargando; trabajar con una pala; trabajar de albañil o demenuzando moldes; subir un nivel inclinado de 8 grados a dos millas por hora; subir las escaleras con una carga pesada (cerca de 50 libras).

13. Va usted a usar la ropa protectora y/o equipo protector (otro que no sea el respirador) cuando esté usando el respirador?: Si/No Si es que si, describa esta ropa protectora y/o equipo protector

14. Va usted a trabajar bajo condiciones calientes? (temperatura que excede 77 grados F): Si/No

15. Va usted a trabajar bajo condiciones húmedas?: Si/No

16. Describa el tipo de trabajo que usted hará mientras que usa el respirador:

17. Describa cualquier otra situación especial o peligrosa que pueda encuentrar cuando esté usando el respirator, (por ejemplo, espacios confinados, gases peligrosos le puedan matar):

18. Proporcione la información siguiente, si la sabe, para cada sustancia tóxica que va a estar expuesto cuando esté usando el respirador:
    Nombre de la primera substancia tóxica:_____
    Maximo nivel de exposición durante el turno de trabajo_____
    Tiempo de exposición del turno_____

    Nombre de la segunda substancia tóxica:_____
    Maximo nivel de exposición durante el turno de trabajo_____
    Tiempo de exposición del turno_____

    Nombre de la tercer substancia tóxica:_____
    Maximo nivel de exposición durante el turno de trabajo_____
    Tiempo de exposición del turno_____
    Nombre de otras sustancias tóxicas que va a estar expuesto mientras que usa su respirador:

19. Describa alguna responsabilidad especial que usted va a tener mientras que usa el respirator que puede afectar la seguridad o el bienestar de otros (por ejemplo, rescate, seguridad):

WAC 296-62-07257 Appendix D: Health Care Provider Respirator Recommendation Form--Non-mandatory This is a non-mandatory appendix to chapter 296-62 WAC, Part E.

This form is for the use of PLHCPs who are providing recommendations to employers regarding employee clearance for respirator use. Completion of this form satisfies the requirement for PLHCP's recommendations as detailed in WAC 296-62-07155. The following information is purposely limited in order to maintain employee confidentiality.

Employee Name: Employer Name: Address: Phone:	Health Care Professional Name: Address: Phone:

Type of Respirator This Individual is Medically Cleared to Use

Check all that apply.

Half-mask Full facepiece mask Helmet Hood Escape
Non-powered cartridge or canister Powered air-purifying cartridge respirator (PAPR)
Supplied-air or Air-line Disposable filtering facepiece (for example N-95)
Self contained breathing apparatus (SCBA): Demand or Pressure demand
Other: _____

Respirator Clearance

Under the conditions described in the supplemental information provided by the employer, this individual: (please check one)

_____ is medically cleared for use of the respirator(s) without limitations.
_____ is medically cleared for use of the respirator(s) with the following limitations:

_____

_____

_____ **is not** medically cleared for use of a respirator.

Workload Limitations

unrestricted heavy medium light

Follow-up Medical Evaluations

This individual will/will not (circle one) require additional follow-up medical evaluation(s). The recommended schedule for follow-up medical evaluations, if necessary, is as follows:

_____

_____

Employee Notification

I certify that the above named individual for whom this respirator clearance form is provided has received a copy of this recommendation.

Signature_____ Date _____
(Physician or other Licensed Health Care Professional)

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07257, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07260 Appendix E: Additional Information Regarding Respirator Selection--Non-Mandatory. This is a non-mandatory appendix to chapter 296-62 WAC, Part E, which includes WAC 296-62-07260 through 296-62-07295.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07260, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07261 How do you classify respiratory hazards? Respiratory hazards are classified into the following categories:

- Oxygen deficient;
- Physical properties (gas, vapor, biological aerosols, and particulate contaminants, which include dust, fog, fume, mist, smoke, and spray);
- Physiological effects on the body (for example, asphyxiant, carcinogenic, or toxic);
- Concentration of toxic material or radioactivity level;
- Established exposure limits; and
- Established immediately dangerous to life or health concentrations.

When selecting a respirator, you must determine which of the categories listed above apply to your workplace.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07261, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07263 What are oxygen deficient respiratory hazards?

(1) The oxygen content of normal air at sea-level conditions is 20.9%.

(2) Minimum legal requirements: An oxygen deficient atmosphere is one that has 19.5% or less oxygen by volume for respirable air at sea-level conditions.

(3) They commonly occur in confined or unventilated cellars, wells, mines, ship holds, tanks, burning buildings, and enclosures containing inert atmospheres.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07263, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07265 What needs to be considered when combinations of contaminants occur in the workplace? Combinations of contaminants (gas, vapor and particulate) may occur simultaneously in the atmosphere. Contaminants may be entirely different substances (dusts and gases from blasting) or the particulate and vapor forms of the same substance. Synergistic effects (joint action of two or more agents that results in an effect that is greater than the sum of their individual effects) may occur. Such effects may require extraordinary protective measures.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07265, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07267 What are the two major types of respirators? Respirators are classified into the following categories:

(1) Air-purifying respirators. The following types of air-purifying respirators are available:

- Particulate-removing;
- Gas- and vapor-removing; and
- Combination particulate- and either gas- or vapor-removing.

(2) Atmosphere-supplying respirators. The following types of atmosphere-supplying respirators are available:

- Supplied-air or airline;
- Combination supplied-air and air-purifying;
- Combination supplied-air with auxiliary self-contained air supply; and
- Self-contained breathing apparatus (SCBA).

[Statutory Authority: RCW 49.17.010., .040, .050. 99-10 (Order 98-10) § 296-62-07267, filed 05/04/99, effective 09/01/99.[

Air-Purifying Respirators (Aprs)

WAC 296-62-07269 What are air-purifying respirators (APRs)?

(1) Air-purifying respirators remove particles, vapors, gases, or a combination of these contaminants by passing contaminated air through a filter, cartridge, or canister. The breathing action of the wearer operates the nonpowered type of respirator. The powered type contains a blower (usually carried by the wearer), that pulls contaminated air through air-purifying media and then blows the purified air to the respirator user. The nonpowered type is equipped with a tight-fitting facepiece or without one (for example, mouthpiece/nose clamp types). The powered type is equipped with a tight-fitting facepiece, helmet, hood, or suit.

(2) Air-purifying respirators are classified into the following categories:

- Particulate-removing respirators;
- Vapor- and gas-removing respirators; and
- Combinations of the above.

(3) Air-purifying respirators (APRs) are available as nonpowered, tight-fitting respirators, powered-air-purifying respirators (PAPRs) and mouthpiece respirators.

(4) A variety of tight-fitting APR styles are available ranging from half facepiece to full facepiece masks, including PAPRs. PAPRs are also available in loose-fitting styles, featuring a hood or helmet instead of a tight-fitting facepiece. Gas masks are only available in the full-facepiece style and some are classified as PAPRs.

(5) Mouthpiece respirators do not provide for a mask-to-face seal and are designed to be worn with a mouth bit and nose clamp.

(6) The most commonly used type of APR is a nonpowered, tight-fitting half-mask. The facepieces available for this type of respirator may be composed of silicone or other elastomeric materials if a cartridge type respirator is needed. Noncartridge types are called filtering facepiece respirators and are primarily composed of fibrous materials.

(7) Disposable options are available for either elastomeric or filtering facepiece type half-masks. Some disposables may last for only a brief period of use while others are designed for prolonged use (designed to have nonreplaceable parts), sometimes referred to as low maintenance respirators. Disposables are generally less expensive than nondisposable type half-masks.

(8) In addition, special cartridge-type half facepiece models may also be available with features designed for specific work operations. For example, low profile type half-masks are available to be worn under welding hoods.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07269, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07271 What are the general limitations for air-purifying respirators (APRs)?

(1) Air-purifying respirators do not protect against oxygen-deficient atmospheres nor against skin irritation by, or absorption through the skin of, airborne contaminants.

(2) The maximum contaminant concentration against which an air-purifying respirator will protect is determined by the design and capacity of the cartridge, canister, or filter and the facepiece-to-face seal on the user. For gases and vapors, the maximum concentration for which the air-purifying element is designed is specified by the manufacturer or is listed on labels of cartridges and canisters.

(3) Nonpowered air-purifying respirators may not provide the assigned level of protection specified unless the facepiece is carefully fitted to the wearer's face to prevent leakage. The time period over which protection is provided is dependent on:

- Canister, cartridge, or filter capacity;
- Concentration of contaminant(s);
- Humidity levels in the ambient atmosphere; and
- The wearer's respiratory rate.

(4) The proper type of canister, cartridge, or filter must be selected for the particular atmosphere and conditions. Nonpowered air-purifying respirators may cause discomfort due to a noticeable resistance to inhalation. This problem is minimized with use of powered respirators. Respirator facepieces present special problems to individuals required to wear prescription lenses (spectacle kits are available from some manufacturers). These devices do have the advantage of being small, light, and simple in operation.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07271, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07273 What are particulate-removing respirators? Particulate-removing respirators are equipped with filter(s) to remove a single type of particulate matter (for example, dust) or a combination of two or more types of particulate matter (for example, dust and fume) from air. The filter may be a replaceable part or a permanent part of the respirator. It may also be a single-use or reusable type of filter.

(1) General limitations. Particulate-removing respirators provide protection against nonvolatile particles only. They do not protect against gases and vapors. They are not for use in atmospheres immediately dangerous to life or health (see WAC 296-62-07132).

(2) Full facepiece particulate respirators provide protection against eye irritation in addition to respiratory protection.

(3) Mouthpiece respirators must be used only for escape. Mouth breathing prevents detection of contaminant by odor. The nose clamp must be securely in place to prevent nasal breathing. A small, lightweight device that can be donned quickly.

(4) In environments with oil aerosols, you must not use “N” type particulate respirators.

(5) Combination particulate- and vapor- and gas-removing respirators are subject to the advantages and disadvantages of the component sections of the combination respirator as described above.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07273, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07275 What are vapor- and gas-removing respirators? Vapor- and gas-removing respirators are equipped with cartridge(s) or canister(s) to remove a single vapor or gas (for example, chlorine gas); a single class of vapors or gases (for example, organic vapors); or a combination of two or more classes or gases (for example, organic vapors, and acidic gases) from air.

(1) General limitations. Vapor and gas removing respirators do not provide protection against particulate contaminants. A rise in canister or cartridge temperature indicates that a gas or vapor is being removed from the inspired air. An uncomfortably high temperature indicates a high concentration of gas or vapor and requires immediate return to fresh air. Use must be avoided unless an ESLI or a change out schedule is available. They are not for use in atmospheres immediately dangerous to life or health.

(2) Full facepiece vapor- and gas-removing respirators provide protection against eye irritation in addition to respiratory protection.

(3) Mouthpiece respirators must be used only for escape. Mouth breathing prevents detection of contaminant by odor. The nose clamp must be securely in place to prevent nasal breathing. These are small lightweight devices that can be put on quickly.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07275, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07277 What are combination particulate- and vapor-and gas-removing respirators?

Combination particulate- and vapor-and gas-removing respirators are equipped with cartridge(s) or canister(s) to remove particulate matter, vapors and gases from air. The filter may be a permanent part or a replaceable part of a cartridge or canister.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07277, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07279 What types of filters, canisters and cartridges are available for air-purifying respirators (APRs)?

(1) Filters. Filters currently available for use against particulate contaminants are appropriate for solid particulates such as dusts or fumes, as well as being appropriate for nonvolatile, liquid particles such as sprays, mists and fogs.

(a) Cartridges or canister filters are available in addition to separate filter pads that can be added to some manufacturers' cartridges. They also may be formed into a filtering facepiece mask or as a wafer-like attachment. Regardless of how they are constructed, particulate filters are classified by physical limitations as "N," "R," and "P". Within each class, manufacturers may supply three different types of filters that reflect the efficiency rating (see below).

Class	Efficiency Rating		
N	95	99	100
R	95	99	100
P	95	99	100

(i) Filters that are classified as N-100, R-100, and P-100 are also referred to as HEPA filters. New particulate filters are more effective than older types of filters referred to as:

- Dust;
- Dust/mist; or
- Dust/fume/mist filters.

These older types of filters have highly variable efficiencies. They are no longer being manufactured and sold.

(ii) Any filter designated with "N" is appropriate for use in environments that do not contain oil. If you have oil aerosols, "R" or "P" designated filters are appropriate for use.

(b) Combination filters. Some vapor and gas cartridges and canisters have an added filter component for particulates. These are available as combination cartridges and will have a separate certification number listed on the respirator, packaging or in the operations manual for each type of contaminant.

(2) Canisters. Gas mask canisters are available for specific contaminants including ammonia, carbon monoxide, chlorine, phosphine and sulfur dioxide. Canisters are also available for general categories of chemical contaminants including acid gases, organic vapors, and pesticides. Canisters attachment options available are chin-, belt- or chest-mounted and a variety of canister sizes are available.

(3) Cartridges (nongas mask canisters). Cartridges are available for protection against specific contaminants and combinations of specific contaminants, including ammonia, chlorine, chlorine dioxide, formaldehyde, hydrogen chloride, hydrogen fluoride, hydrogen sulfide, mercury, methylamine, sulfur dioxide and vinyl chloride. Cartridges are also available for protection against general categories of chemical contaminants, including organic vapors, paints/lacquers/enamels and pesticides. Cartridge attachment options available include face-, chin-, belt- or helmet-mounted.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07279, filed 05/04/99, effective 09/01/99.]

Atmosphere-Supplying Respirators

WAC 296-62-07281 How do atmosphere-supplying respirators work?

(1) Atmosphere-supplying respirators supply a respirable atmosphere to the wearer.

(2) The two types of atmosphere-supplying respirators are:

- Self-contained breathing apparatus (SCBA); and
- Supplied-air respirators.

[Statutory Authority: RCW 439.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07281, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07283 What are the capabilities and limitations of atmosphere-supplying respirators? See WAC 296-62-07180 for the requirements on breathing gases used with atmosphere-supplying respirators.

(1) Capabilities. Atmosphere-supplying respirators provide protection against oxygen deficient and toxic atmospheres. The breathing atmosphere is independent of contaminated atmospheric conditions.

(2) General limitations. Except for some supplied-air suits, no protection is provided against skin irritation by materials such as ammonia and hydrogen chloride, or against absorption of materials such as hydrogen cyanide or organo-phosphate pesticides through the skin. Facepieces present special problems to individuals required to wear prescription lenses. Use of atmosphere-supplying respirators in atmospheres immediately dangerous to life or health is limited to specific devices under specified conditions (see WAC 296-62-07132).

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07283, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07285 What is a supplied-air respirator? A supplied-air (or air-line) respirator provides respirable air through a small-diameter hose from a compressor or compressed-air cylinder(s). The hose is attached to the wearer by a belt or other suitable means and can be detached rapidly in an emergency. A flow-control valve or orifice is provided to govern the rate of air flow to the wearer. Exhaled air passes to the ambient atmosphere through a valve(s) or opening(s) in the enclosure (facepiece, helmet, hood, or suit). Up to 300 feet (91 meters) of hose length is permissible. Hose supplied by the manufacturer and recommended operating pressures and hose lengths must be used.

Supplied-air respirators are classified in the following ways:

(1) Continuous-flow respirators, which are equipped with a facepiece, hood, helmet, or suit. At least 115 liters (four cubic feet) of air per minute to tight-fitting facepieces and 170 liters (six cubic feet) of air per minute to loose fitting helmets, hoods and suits are required. Air is supplied to a suit through a system of internal tubes to the head, trunk and extremities through valves located in appropriate parts of the suit.

(2) Demand type (negative pressure) respirators, which are only equipped with a facepiece. The demand valve permits flow of air only during inhalation.

(3) Pressure-demand type (positive pressure) respirators, which are only equipped with a facepiece. A positive pressure is maintained in the facepiece.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07285, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07287 What are the general capabilities and limitations of supplied-air respirators?

(1) Capabilities. The respirable air supply is not limited to the quantity the individual can carry, and the devices are lightweight and simple. The demand type produces a negative pressure in the facepiece on inhalation, whereas continuous-flow and pressure-demand types maintain a positive-pressure in the respirator-inlet covering and are less apt to permit inward leakage of contaminants. Supplied-air suits may protect against atmospheres that irritate the skin or that may be absorbed through the unbroken skin.

(2) Limitations. Employees are restricted in movement by the hose and must return to a respirable atmosphere by retracing their route of entry. The hose may be severed or pinched off. Supplied-air respirators provide no protection if the air supply fails. Some contaminants, such as tritium, may penetrate the material of an supplied-air suit and limit its effectiveness. Other contaminants, such as fluorine, may react chemically with the material of a supplied-air suit and damage it.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07287, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07289 What are combination supplied-air and air-purifying respirators? Combination supplied-air and air-purifying respirators provide the wearer with the option of using either of two different modes of operation:

(1) A supplied-air respirator with an auxiliary air-purifying attachment which provides protection in the event the air supply fails; or

(2) The advantages and disadvantages previously described for supplied-air and air-purifying respirators apply when these respirators are used in combination. The mode with the greater limitations (air-purifying mode) will generally determine the overall capabilities and limitations of the respirator, since the wearer may for some reason fail to change the mode of operation even though conditions require such a change.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07289, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07291 What are combination supplied-air respirators with auxiliary self-contained air supply? Some combination supplied-air respirators have an auxiliary self-contained air supply. To escape from a hazardous atmosphere in the event the primary air supply fails to operate, the wearer switches to the auxiliary self-contained air supply. Devices approved for both entry into and escape from dangerous atmospheres have a low-pressure warning alarm and contain at least a 5-minute self-contained air supply. The auxiliary self-contained air supply on this type of device allows the wearer to escape from a dangerous atmosphere. This device with auxiliary self-contained air supply is approved for escape and may be used for entry when it contains at least a 15-minute auxiliary self-contained air supply and not more than 20 percent of the rated self-contained air supply is used during entry (see WAC 296-62-07132).

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07291, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07293 What is a self-contained breathing apparatus respirator (SCBA)? SCBAs are respirators designed so that the supply of air, oxygen, or oxygen-generated material is carried by the wearer. They are normally equipped with a full facepiece, but may be equipped with a half-mask facepiece, helmet, hood or mouthpiece and nose clamp.

SCBAs are classified in the following ways:

(1) Closed-circuit SCBA (oxygen only, negative pressure or positive pressure). There are two types of closed-circuit SCBAs. They are:

(a) Compressed liquid oxygen respirators, which are equipped with a facepiece or mouthpiece and nose clamp. High-pressure oxygen from a gas cylinder passes through a high-pressure reducing valve and, in some designs, through a low-pressure admission valve to a breathing bag or container. Liquid oxygen is converted to low-pressure gaseous oxygen and delivered to the breathing bag. The wearer inhales from the bag through a corrugated tube connected to a mouthpiece or facepiece and a one-way check valve. Exhaled air passes through another check valve and tube into a container of carbon-dioxide removing chemical and reenters the breathing bag. Make-up oxygen enters the bag continuously or as the bag deflates sufficiently to actuate an admission valve. A pressure-relief system is provided, and a manual bypass and saliva trap may be provided depending upon the design.

(b) Oxygen-generating respirators, which are equipped with a facepiece or mouthpiece and nose clamp. Water vapor in the exhaled breath reacts with the chemical in the canister to release oxygen to the breathing bag. The wearer inhales from the bag through a corrugated tube and one-way check valve at the facepiece. Exhaled air passes through a second check valve/breathing tube assembly into the canister. The oxygen-release rate is governed by the volume of exhaled air. Carbon dioxide in the exhaled breath is removed by the canister fill.

(2) Open-circuit (SCBA) (compressed air, compressed oxygen, liquid air, liquid oxygen). A bypass system is provided in case of regulator failure except on escape-type units. There are two types of open-circuit SCBAs. They are:

(a) Demand-type respirators, which are equipped with a facepiece or mouthpiece and nose clamp. The demand valve permits oxygen or air flow only during inhalation. Exhaled breath passes to ambient atmosphere through a valve(s) in the facepiece.

(b) Pressure-demand type respirators, which are equipped with a facepiece only. Positive pressure is maintained in the facepiece. The apparatus may have provision for the wearer to select the demand or pressure-demand mode of operation, in which case only the demand mode must be used when putting on or removing the apparatus.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07293, filed 05/04/99, effective 09/01/99.]

WAC 296-62-07295 What are the limitations for self-contained breathing apparatus respirators (SCBA)?

(1) The period over which the SCBAs will provide protection is limited by the amount of air or oxygen in the apparatus, the ambient atmospheric pressure (service life of open-circuit devices is cut in half by a doubling of the atmospheric pressure), and the type of work being performed. Some SCBA devices have a short service life (less than 15 minutes) and are suitable only for escape (self-rescue) from an irreparable atmosphere. Chief limitations of SCBA devices are their weight, bulk, limited service life, and the training requirements for their maintenance and safe use.

(2) What are the limitations for closed-circuit SCBAs?

The closed-circuit operation conserves oxygen and permits longer service life at reduced weight. The negative-pressure type produces a negative pressure in the respiratory-inlet covering during inhalation, and this may permit inward leakage of contaminants; the positive-pressure type always maintains a positive pressure in the respiratory-inlet covering and is less apt to permit inward leakage of contaminants.

(3) What are the limitations for open circuit SCBAs?

The demand type produces a negative pressure in the respiratory-inlet covering during inhalation, whereas the pressure-demand type maintains a positive pressure in the respiratory-inlet covering during inhalation and is less apt to permit inward leakage of contaminants.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07295, filed 05/04/99, effective 09/01/99.]

PART F
CARCINOGENS

WAC

WAC 296-62-073 Carcinogens-Scope and application.

(1) All sections of this chapter which include WAC 296-62-073 in the section number apply to the manufacturing, processing, repackaging, releasing, handling or storing of carcinogens.

(2) This section shall not apply to solid or liquid mixtures containing less than 0.1 percent by weight or volume of the carcinogens listed in WAC 296-62-07302.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-073, filed 11/30/87. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-073, filed 11/13/80; Order 76-6, § 296-62-073, filed 3/1/76; Order 74-35, § 296-62-073, filed 9/20/74.]

WAC 296-62-07302 List of carcinogens.

(1) The following substances are deemed to be carcinogens for the purposes of WAC 296-62-073 through 296-62-07316.

(2) Any reference to carcinogens in WAC 296-62-07304 through 296-62-07316 shall mean only those carcinogens listed in WAC 296-62-07302.

(a) 4-Nitrobiphenyl - Chemical Abstracts Service Registry Number 92-93-3.

(b) Alpha-Naphthylamine - Chemical Abstracts Service Registry Number 134-32-7.

(c) 4,4' Methylene bis (2 - chloroaniline) - Chemical Abstracts Service Registry Number 101-14-4.

(d) Methyl chloromethyl ether - Chemical Abstracts Service Registry Number 107-30-2.

(e) 3,3'-Dichlorobenzidine (and its salts) - Chemical Abstracts Service Registry Number 91-94-1.

(f) Bis-Chloromethyl ether - Chemical Abstracts Service Registry Number 542-88-1.

(g) Beta-Naphthylamine - Chemical Abstracts Service Registry Number 91-59-8.

(h) Benzidine - Chemical Abstracts Service Registry Number 92-87-5.

(i) 4-Aminodiphenyl - Chemical Abstracts Service Registry Number 92-67-1.

WAC 296-62-07302 (Cont.)

(j) Ethyleneimine - Chemical Abstracts Service Registry Number 151-56-4.

(k) Beta-Propiolactone - Chemical Abstracts Service Registry Number 57-57-8.

(l) 2-Acetylaminofluorene - Chemical Abstracts Service Registry Number 53-96-3.

(m) 4-Dimethylaminoazobenzene - Chemical Abstract Service Registry Number 60-11-7.

(n) N-Nitrosodimethylamine - Chemical Abstracts Service Registry Number 62-75-9.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20), § 296-62-07302, filed 06/05/02, effective 08/01/02. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-62-07302, filed 7/20/94, effective 9/20/94. Statutory Authority: RCW 49.17.040 and 49.17.050. 85-10-004 (Order 85-09), § 296-62-07302, filed 4/19/85; 82-13-045 (Order 82-22), § 296-62-07302, filed 6/11/82; 81-07-048 (Order 81-4), § 296-62-07302, filed 3/17/81. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07302, filed 11/13/80.]

WAC 296-62-07304 Definitions. The definitions set forth in this section apply throughout WAC 296-62-073 through 296-62-07316.

(1) **Absolute filter** - is one capable of retaining 99.97 percent of a mono disperse aerosol of 0.3 micron size particles.

(2) **Authorized employee** - an employee whose duties require him to be in the regulated area and who has been specifically assigned to those duties by the employer.

(3) **Clean change room** - a room where employees put on clean clothing and/or protective equipment in an environment free of carcinogens listed in WAC 296-62-07302. The clean change room shall be contiguous to and have an entry from a shower room, when the shower room facilities are otherwise required in this section.

(4) **Closed system** - an operation involving carcinogens listed in WAC 296-62-07302 where containment prevents the release of carcinogens.

(5) **Decontamination** - the inactivation of a carcinogen listed in WAC 296-62-07302 or its safe disposal.

(6) **Disposal** - the safe removal of a carcinogen listed in WAC 296-62-07302 from the work environment.

(7) **Emergency** - an unforeseen circumstance or set of circumstances resulting in the release of a carcinogen which may result in exposure to or contact with any carcinogen listed in WAC 296-62-07302.

(8) **External environment** - any environment external to regulated and nonregulated areas.

(9) **Isolated system** - a fully enclosed structure other than the vessel of containment of a listed carcinogen which is impervious to the passage of listed carcinogens and which would prevent the entry of carcinogens into regulated areas, nonregulated areas, or the external environment, should leakage or spillage from the vessel of containment occur.

(10) **Laboratory-type hood** - a device enclosed on three sides and the top and bottom, designed and maintained so as to draw air inward at an average linear face velocity of 150 feet per minute with a minimum of 125 feet per minute, designed, constructed and maintained such that an operation involving a listed carcinogen within the hood does not require the insertion of any portion of any employees' body other than his hands and arms.

(11) **Nonregulated area** - any area under the control of the employer where entry and exit is neither restricted nor controlled.

WAC 296-62-07304 (Cont.)

(12) **Open-vessel system** - an operation involving listed carcinogens in an open vessel, which is not in an isolated system, a laboratory-type hood, nor in any other system affording equivalent protection against the entry of carcinogens into regulated areas, nonregulated areas, or the external environment.

(13) **Protective clothing** - clothing designed to protect an employee against contact with or exposure to listed carcinogens.

(14) **Regulated area** - an area where entry and exit is restricted and controlled.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20), § 296-62-07304, filed 06/05/02, effective 08/01/02. Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07304, filed 11/30/87. Statutory Authority: RCW 49.17.040 and 49.17.050. 81-07-048 (Order 81-4), § 296-62-07304, filed 3/17/81. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07304, filed 11/13/80.]

WAC 296-62-07306 Requirements for areas containing carcinogens listed in WAC 296-62-07302.

(1) A regulated area shall be established by an employer where listed carcinogens are manufactured, processed, used, repackaged, released, handled or stored.

(2) All such areas shall be controlled in accordance with the requirements for the following category or categories describing the operation involved:

(a) Isolated systems. Employees working with carcinogens within an isolated system such as a "glove box." shall wash their hands and arms upon completion of the assigned task and before engaging in other activities not associated with the isolated system.

(b) Closed system operation. Within regulated areas where carcinogens are stored in sealed containers, or contained in a closed system including piping systems with any sample ports or openings closed while carcinogens are contained within:

(i) Access shall be restricted to authorized employees only;

(ii) Employees shall be required to wash hands, forearms, face and neck upon each exit from the regulated areas, close to the point of exit and before engaging in other activities.

(c) Open vessel system operations. Open vessel system operations as defined in WAC 296-62-07304(12) are prohibited.

(d) Transfer from a closed system. Charging or discharging point operations, or otherwise opening a closed system. In operations involving "laboratory-type hoods," or in locations where a carcinogen is contained in an otherwise "closed system," but is transferred, charged, or discharged into other normally closed containers, the provisions of this section shall apply.

(i) Access shall be restricted to authorized employees only;

(ii) Each operation shall be provided with continuous local exhaust ventilation so that air movement is always from ordinary work areas to the operation. Exhaust air shall not be discharged to regulated areas, nonregulated areas or the external environment unless decontaminated. Clean makeup air shall be introduced in sufficient volume to maintain the correct operation of the local exhaust system.

(iii) Employees shall be provided with, and required to wear, clean, full body protective clothing (smocks, coveralls, or long-sleeved shirt and pants), shoe covers and gloves prior to entering the regulated area.

WAC 296-62-07306 (Cont.)

(iv) Employees engaged in handling operations involving the following carcinogens must be provided with and required to wear and use a full-face, supplied-air respirator, of the continuous flow or pressure-demand type as required in chapter 296-62 WAC, Part E:

- Methyl Chloromethyl Ether;
- bis-Chloromethyl Ether;
- Ethylenemine;
- beta-Propiolactone;
- 4-Amino Diphenyl.

(v) Employees engaged in handling operations involving:

- 4-Nitrobiphenyl;
- alpha-Naphthylamine;
- 4,4'Methylene bis (2-Chloroaniline);
- 3,3'Dichlorobenzidine (and its salts);
- beta-Naphthylamine;
- benzidine;
- 2-acetylamino fluroene;
- 4-imethylaminoazobenzene;
- n-nitrosodimethylamine.

must be provided with, and required to wear and use, a half-face, filter-type respirator certified for solid or liquid particulates with minimum efficiency rating of 95% as required in chapter 296-62 WAC, Part E. A respirator affording higher levels of protection than this respirator may be substituted.

(vi) Prior to each exit from a regulated area, employees shall be required to remove and leave protective clothing and equipment at the point of exit and at the last exit of the day, to place used clothing and equipment in impervious containers at the point of exit for purposes of decontamination or disposal. The contents of such impervious containers shall be identified, as required under WAC 296-62-07310 (2), (3) and (4).

(vii) Employees shall be required to wash hands, forearms, face and neck on each exit from the regulated area, close to the point of exit, and before engaging in other activities.

(viii) Employees shall be required to shower after the last exit of the day.

(ix) Drinking fountains are prohibited in the regulated area.

(e) Maintenance and decontamination activities. In clean up of leaks or spills, maintenance or repair operations on contaminated systems or equipment, or any operations involving work in an area where direct contact with carcinogens could result, each authorized employee entering the area shall:

(i) Be provided with and required to wear, clean, impervious garments, including gloves, boots and continuous-air supplied hood in accordance with WAC 296-800-160, and respiratory protective equipment required by this chapter 296-62 WAC;

(ii) Be decontaminated before removing the protective garments and hood;

(iii) Be required to shower upon removing the protective garments and hood.

WAC 296-62-07306 (Cont.)

(f) Laboratory activities. The requirements of this subdivision shall apply to research and quality control activities involving the use of carcinogens listed in WAC 296-62-07302.

(i) Mechanical pipetting aids shall be used for all pipetting procedures.

(ii) Experiments, procedures and equipment which could produce aerosols shall be confined to laboratory-type hoods or glove boxes.

(iii) Surfaces on which carcinogens are handled shall be protected from contamination.

(iv) Contaminated wastes and animal carcasses shall be collected in impervious containers which are closed and decontaminated prior to removal from the work area. Such wastes and carcasses shall be incinerated in such a manner that no carcinogenic products are released.

(v) All other forms of listed carcinogens shall be inactivated prior to disposal.

(vi) Laboratory vacuum systems shall be protected with high efficiency scrubbers or with disposable absolute filters.

(vii) Employees engaged in animal support activities shall be:

(A) Provided with, and required to wear, a complete protective clothing change, clean each day, including coveralls or pants and shirt, foot covers, head covers, gloves, and appropriate respiratory protective equipment or devices; and

(B) Prior to each exit from a regulated area, employees shall be required to remove and leave protective clothing and equipment at the point of exit and at the last exit of the day, to place used clothing and equipment in impervious containers at the point of exit for purposes of decontamination or disposal. The contents of such impervious containers shall be identified as required under WAC 296-62-07310 (2), (3) and (4).

(C) Required to wash hands, forearms, face and neck upon each exit from the regulated area close to the point of exit, and before engaging in other activities; and

(D) Required to shower after the last exit of the day.

(viii) Employees, other than those engaged only in animal support activities, each day shall be:

(A) Provided with and required to wear a clean change of appropriate laboratory clothing, such as a solid front gown, surgical scrub suit, or fully buttoned laboratory coat.

(B) Prior to each exit from a regulated area, employees shall be required to remove and leave protective clothing and equipment at the point of exit and at the last exit of the day, to place used clothing and equipment in impervious containers at the point of exit for purposes of decontamination or disposal. The contents of such impervious containers shall be identified as required under WAC 296-62-07310 (2), (3) and (4).

WAC 296-62-07306 (Cont.)

(C) Required to wash hands, forearms, face and neck upon each exit from the regulated area close to the point of exit, and before engaging in other activities.

(ix) Air pressure in laboratory areas and animal rooms where carcinogens are handled and bioassay studies are performed shall be negative in relation to the pressure in surrounding areas. Exhaust air shall not be discharged to regulated areas, nonregulated areas or the external environment unless decontaminated.

(x) There shall be no connection between regulated areas and any other areas through the ventilation system.

(xi) A current inventory of the carcinogens shall be maintained.

(xii) Ventilated apparatus such as laboratory-type hoods, shall be tested at least semi-annually or immediately after ventilation modification or maintenance operations, by personnel fully qualified to certify correct containment and operation.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07306, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07271, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 96-09-030, § 296-62-07306, filed 4/10/96, effective 6/1/96. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-16-009 (Order 86-28), § 296-62-07306, filed 7/25/86; 85-10-004 (Order 85-09), § 296-62-07306, filed 4/19/85. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-015 (Order 81-20), § 296-62-07306, filed 7/27/81. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07306, filed 11/13/80.]

WAC 296-62-07308 General regulated area requirements.

(1) **Respirator program.** The employer must implement a respiratory protection program as required in chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and (5) and 296-62-07131).

(2) **Emergencies.** In an emergency, immediate measures including, but not limited to, the requirements of (a), (b), (c), (d) and (e) of this subsection shall be implemented.

(a) The potentially affected area shall be evacuated as soon as the emergency has been determined.

(b) Hazardous conditions created by the emergency shall be eliminated and the potentially affected area shall be decontaminated prior to the resumption of normal operations.

(c) Special medical surveillance by a physician shall be instituted within twenty-four hours for employees present in the potentially affected area at the time of the emergency. A report of the medical surveillance and any treatment shall be included in the incident report, in accordance with WAC 296-62-07312(2).

(d) Where an employee has a known contact with a listed carcinogen, such employee shall be required to shower as soon as possible, unless contraindicated by physical injuries.

(e) An incident report on the emergency shall be reported as provided in WAC 296-62-07312(2).

(3) **Hygiene facilities and practices.**

(a) Storage or consumption of food, storage or use of containers of beverages, storage or application of cosmetics, smoking, storage of smoking materials, tobacco products or other products for chewing, or the chewing of such products, are prohibited in regulated areas.

(b) Where employees are required by this section to wash, washing facilities shall be provided in

accordance with WAC 296-800-230.

WAC 296-62-07308 (Cont.)

(c) Where employees are required by this section to shower, shower facilities shall be provided.

(i) One shower shall be provided for each ten employees of each sex, or numerical fraction thereof, who are required to shower during the same shift.

(ii) Body soap or other appropriate cleansing agents convenient to the showers shall be provided as specified in WAC 296-24-12009, of the general safety and health standards.

(iii) Showers shall be provided with hot and cold water feeding a common discharge line.

(iv) Employees who use showers shall be provided with individual clean towels.

(d) Where employees wear protective clothing and equipment, clean change rooms shall be provided and shall be equipped with storage facilities for street clothes and separate storage facilities for the protective clothing for the number of such employees required to change clothes.

(e) Where toilets are in regulated areas, such toilets shall be in a separate room.

(4) **Contamination control.**

(a) Regulated areas, except for outdoor systems, shall be maintained under pressure negative with respect to nonregulated areas. Local exhaust ventilation may be used to satisfy this requirement. Clean makeup air in equal volume shall replace air removed.

(b) Any equipment, material, or other item taken into or removed from a regulated area shall be done so in a manner that does not cause contamination in nonregulated areas or the external environment.

(c) Decontamination procedures shall be established and implemented to remove carcinogens from the surfaces of materials, equipment and the decontamination facility.

(d) Dry sweeping and dry mopping are prohibited.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07308, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07308, filed 05/04/99, effective 09/01/99.] Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), § 296-62-07308, filed 11/30/83. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07308, filed 11/13/80.]

WAC 296-62-07310 Signs, information and training.

(1) **Signs.**

(a) Entrances to regulated areas shall be posted with signs bearing the legend:

CANCER SUSPECT AGENT
AUTHORIZED PERSONNEL ONLY

(b) Entrances to regulated areas containing operations covered in WAC 296-62-07306 (2)(e) shall be posted with signs bearing the legend:

CANCER-SUSPECT AGENT EXPOSED IN THIS AREA
IMPERVIOUS SUIT INCLUDING GLOVES,
BOOTS, AND AIR-SUPPLIED HOOD
REQUIRED AT ALL TIMES
AUTHORIZED PERSONNEL ONLY

WAC 296-62-07310 (Cont.)

(c) Appropriate signs and instructions shall be posted at the entrance to, and exit from, regulated areas, informing employees of the procedures that must be followed in entering and leaving a regulated area.

(2) **Container contents, identification.**

(a) Containers of carcinogens named in WAC 296-62-07302 and containers required in WAC 296-62-07306 (2)(d)(v) and 296-62-07306 (2)(f)(vii)(B) and 296-62-07306 (2)(f)(viii)(B) which are accessible only to, and handled only by authorized employees, or by other employees training in accordance with WAC 296-62-07310(5), may have contents identification limited to a generic or proprietary name, or other proprietary identification of the carcinogen and percent.

(b) Containers of carcinogens and containers required under WAC 296-62-07306 (2)(d)(v) and 296-62-07306 (2)(f)(vii)(B) and 296-62-07306 (2)(f)(viii)(B) which are accessible to, or handled by employees other than authorized employees or employees trained in accordance with WAC 296-62-07310(5) shall have contents identification which includes the full chemical name and Chemical Abstracts Service Registry number as listed in WAC 296-62-07302.

(c) Containers shall have the warning words “cancer-suspect agent” displayed immediately under or adjacent to the contents identification.

(d) Containers which have carcinogenic contents with corrosive or irritating properties shall have label statements warning of such hazards, noting, if appropriate, particularly sensitive or affected portions of the body.

(3) **Lettering.** Lettering on signs and instructions required by WAC 296-62-07310(1) shall be a minimum letter height of two inches. Labels on containers required under this section shall not be less than one-half the size of the largest lettering on the package, and not less than eight point type in any instance: Provided, that no such required lettering need be more than one inch in height.

(4) **Prohibited statements.** No statements shall appear on or near any required sign, label, or instruction which contradicts or detracts from the effect of any required warning, information or instruction.

(5) **Training and indoctrination.**

(a) Each employee prior to being authorized to enter a regulated area, shall receive a training and indoctrination program including, but not necessarily limited to:

(i) The nature of the carcinogenic hazards of listed carcinogens, including local and systemic toxicity;

(ii) The specific nature of the operation involving carcinogens which could result in exposure;

(iii) The purpose for and application of the medical surveillance program, including, as appropriate, methods of self-examination;

(iv) The purpose for and application of decontamination practices and purposes;

(v) The purpose for and significance of emergency practices and procedures;

(vi) The employee's specific role in emergency procedures;

WAC 296-62-07310 (Cont.)

(vii) Specific information to aid the employee in recognition and evaluation of conditions and situations which may result in the release of listed carcinogens;

(viii) The purpose for and application of specific first-aid procedures and practices;

(ix) A review of this section at the employee's first training and indoctrination program and annually thereafter.

(b) Specific emergency procedures shall be prescribed, and posted, and employees, shall be familiarized with their terms, and rehearsed in their application.

(c) All materials relating to the program shall be provided upon request to the director.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07310, filed 11/30/87. Statutory Authority: RCW 49.17.040 and 49.17.050. 81-07-048 (Order 81-4), § 296-62-07310, filed 3/17/81. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07310, filed 11/13/80.]

WAC 296-62-07312 Reports.

(1) **Operations.** Not later than October 30, 1974, the information required in WAC 296-62-07312 (1)(a), (b), (c) and (d) of this section must be reported in writing to the Department of Labor and Industries, WISHA Services Division, Policy and Technical Services, P.O. Box 44610, Olympia, WA 98504-4610. Any change in the information must also be reported in writing within 15 calendar days of the change.

(a) A brief description and in plant location of the area(s) regulated and the address of each regulated area;

(b) The name(s) and other identifying information as to the presence of listed carcinogens in each regulated area;

(c) The number of employees in each regulated area, during normal operations including maintenance activities; and

(d) The manner in which a carcinogen is present in each regulated area; e.g., whether it is manufactured, processed, used, repackaged, released, stored, or otherwise handled.

(2) **Incidents.** Incidents which result in the release of a listed carcinogen into any area where employees may be potentially exposed shall be reported in accordance with this subsection.

(a) The occurrence of the incident, including any facts obtainable at that time, as well as a report on any medical treatment of affected employees, must be reported within 24 hours to the Department of Labor and Industries, WISHA Services Division, Policy and Technical Services, P.O. Box 44610, Olympia, WA 98504-4610.

(b) A written report must be filed with the Department of Labor and Industries, WISHA Services Division, Policy and Technical Services, P.O. Box 44610, Olympia, WA 98504-4610, within 15 calendar days after the incident occurs, and must include:

(i) A specification of the amount of material released, the amount of time involved, and an explanation of the procedure used in determining this figure;

(ii) A description of the area involved, and the extent of known and possible employee exposure and area contamination;

(iii) A report of any medical treatment of affected employees, and any medical surveillance program implemented; and

WAC 296-62-07312 (Cont.)

(iv) An analysis of the circumstances of the incident, and measures taken or to be taken, with specific completion dates, to avoid further similar releases.

CARCINOGEN STANDARD REPORT

Company: ---------- Prepared By: ----------
Plant Address: ---------- Title: ----------
Date: ----------

Compound and Other Identifying Information	Description of Inplant Location of Regulated Area*	Number of Employees in Each Regulated Area* Normally Maintenance	Manner** In Which Compound is Present in Each Regulated Area*

* See WAC 296-62-07308 for definition of "regulated area."
** Indicated whether manufactured, processed, used, repackaged, released, stored, or if otherwise handled (describe).
[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20), § 296-62-07312, filed 06/05/02, effective 08/01/02. Statutory Authority: RCW 49.17.040 and 49.17.050. 81-07-048 (Order 81-4), § 296-62-07312, filed 3/17/81. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07312, filed 11/13/80.]

WAC 296-62-07314 Medical surveillance.

(1) At no cost to the employee, a program of medical surveillance must be established and implemented for employees considered for assignment to enter regulated areas, and for authorized employees.

(2) **Examinations.**

(a) Before an employee is assigned to enter a regulated area, a preassignment physical examination by a physician must be provided and must include a personal history of the employee and/or his/her family and occupational background, including genetic and environmental factors.

(i) Taking of employees' medical history and background history must be considered to be a routine part of standard medical practice.

(ii) This provision does not require "genetic testing" of any employee.

(iii) This provision does not require the exclusion of otherwise qualified employees from jobs on the basis of genetic factors.

(b) Authorized employees must be provided periodic physical examination, not less often than annually, following the preassignment examination.

(c) In all physical examinations, the examining physician must be requested to consider whether there exist conditions of increased risk, including reduced immunological competence, pregnancy, cigarette smoking, and those undergoing treatment with steroids or cytotoxic agents.

(3) **Records.**

(a) Employers of employees examined pursuant to this subdivision must maintain complete and accurate records of all such medical examinations. Records must be maintained for the duration of the employee's employment. Upon termination of the employee's employment, including retirement or death, or in the event that the employer ceases business without a successor, records, or notarized true copies thereof, must be forwarded by registered mail to the director.

WAC 296-62-07314 (Cont.)

(b) Records required by this section must be provided upon request to employees, designated representatives, and the director in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217.

(c) Any employer who requests a physical examination of an employee or prospective employee as required by this section must obtain from the physician a statement of the employee's suitability for employment in the specific exposure.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20) § 296-62-07314, filed 06/05/02, effective 08/01/02. Statutory Authority: Chapter 49.17 RCW. 91-03-044 (Order 90-18), § 296-62-07314, filed 1/10/91, effective 2/12/91; 90-03-029 (Order 89-20), § 296-62-07314, filed 1/11/90, effective 2/26/90. Statutory Authority: RCW 49.17.040 and 49.17.050. 83-15-017 (Order 83-19), § 296-62-07314, filed 7/13/83, effective 9/12/83. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07314, filed 11/13/80.]

WAC 296-62-07316 Premixed solutions.

(1) Where 4,4'-Methylene bis (2-chloroaniline) is present only in a single solution at a temperature not exceeding 220°F. the establishment of a regulated area is not required; however,

(a) Only authorized employees shall be permitted to handle such materials.

(b) Each day employees shall be provided with and required to wear a clean change of protective clothing (smocks, coveralls, or long-sleeved shirts and pants), gloves and other protective garments and equipment necessary to prevent contact with the solution in the process used.

(c) Employees shall be required to remove and leave protective clothing and equipment when leaving the work area at the end of the work day, or at any time solution is spilled on such clothing or equipment. Used clothing and equipment shall be placed in impervious containers for purposes of decontamination or disposal. The contents of such impervious containers shall be identified, as required under WAC 296-62-07310 (2), (3) and (4).

(d) Employees shall be required to wash hands and face after removing such clothing and equipment and before engaging in other activities.

(e) Employees assigned to work covered by this section shall be deemed to be working in regulated areas for the purposes of WAC 296-62-07308 (1), (2)(a) and (b), and (3)(c) and (d), WAC 296-62-07310, 296-62-07312 and 296-62-07314.

(f) Work areas where solution may be spilled shall be:

(i) Covered daily or after any spill with a clean covering; or

(ii) Clean thoroughly, daily and after any spill.

[Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), § 296-62-07316, filed 11/13/80.]

WAC 296-62-07329 Vinyl chloride.

(1) **Scope and application.**

(a) This section includes requirements for the control of employee exposure to vinyl chloride (chloroethene), Chemical Abstracts Service Registry No. 75014.

(b) This section applies to the manufacture, reaction, packaging, repackaging, storage, handling or use of vinyl chloride or polyvinyl chloride, but does not apply to the handling or use of fabricated products made of polyvinyl chloride.

(c) This section applies to the transportation of vinyl chloride or polyvinyl chloride except to the extent that the department of transportation may regulate the hazards covered by this section.

(2) **Definitions.**

(a) **"Action level"** means a concentration of vinyl chloride of 0.5 ppm averaged over an 8-hour work day.

(b) **"Authorized person"** means any person specifically authorized by the employer whose duties require him/her to enter a regulated area or any person entering such an area as a designated representative of employees for the purpose of exercising an opportunity to observe monitoring and measuring procedures.

(c) **"Director"** means the director of department of labor and industries or his/her designated representative.

(d) **"Emergency"** means any occurrence such as, but not limited to, equipment failure, or operation of a relief device which is likely to, or does, result in massive release of vinyl chloride.

(e) **"Fabricated product"** means a product made wholly or partly from polyvinyl chloride, and which does not require further processing at temperatures, and for times, sufficient to cause mass melting of the polyvinyl chloride resulting in the release of vinyl chloride.

(f) **"Hazardous operation"** means any operation, procedure, or activity where a release of either vinyl chloride liquid or gas might be expected as a consequence of the operation or because of an accident in the operation, which would result in an employee exposure in excess of the permissible exposure limit.

(g) **"Polyvinyl chloride"** means polyvinyl chloride homopolymer or copolymer before such is converted to a fabricated product.

(h) **"Vinyl chloride"** means vinyl chloride monomer.

(3) **Permissible exposure limit.**

(a) No employee may be exposed to vinyl chloride at concentrations greater than 1 ppm averaged over any 8-hour period, and

(b) No employee may be exposed to vinyl chloride at concentrations greater than 5 ppm averaged over any period not exceeding 15 minutes.

(c) No employee may be exposed to vinyl chloride by direct contact with liquid vinyl chloride.

WAC 296-62-07329 (Cont.)

(4) **Monitoring.**

(a) A program of initial monitoring and measurement shall be undertaken in each establishment to determine if there is any employee exposed, without regard to the use of respirators, in excess of the action level.

(b) Where a determination conducted under subdivision (a) of this subsection shows any employee exposures without regard to the use of respirators, in excess of the action level, a program for determining exposures for each such employee shall be established. Such a program:

(i) Shall be repeated at least monthly where any employee is exposed, without regard to the use of respirators, in excess of the permissible exposure limit.

(ii) Shall be repeated not less than quarterly where any employee is exposed, without regard to the use of respirators, in excess of the action level.

(iii) May be discontinued for any employee only when at least two consecutive monitoring determinations, made not less than 5 working days apart, show exposures for that employee at or below the action level.

(c) Whenever there has been a production, process or control change which may result in an increase in the release of vinyl chloride, or the employer has any other reason to suspect that any employee may be exposed in excess of the action level, a determination of employee exposure under subdivision (a) of this subsection shall be performed.

(d) The method of monitoring and measurement shall have an accuracy (with a confidence level of 95 percent) of not less than plus or minus 50 percent from 0.25 through 0.5 ppm, plus or minus 35 percent from over 0.5 ppm through 1.0 ppm, plus or minus 25 percent over 1.0 ppm, (methods meeting these accuracy requirements are available from the director).

(e) Employees or their designated representatives shall be afforded reasonable opportunity to observe the monitoring and measuring required by this subsection.

(5) **Regulated area.**

(a) A regulated area shall be established where:

(i) Vinyl chloride or polyvinyl chloride is manufactured, reacted, repackaged, stored, handled or used; and

(ii) Vinyl chloride concentrations are in excess of the permissible exposure limit.

(b) Access to regulated areas shall be limited to authorized persons.

(6) **Methods of compliance.** Employee exposures to vinyl chloride shall be controlled to at or below the permissible exposure limit provided in subsection (3) of this section by engineering, work-practice, and personal protective controls as follows:

(a) Feasible engineering and work-practice controls shall immediately be used to reduce exposures to at or below the permissible exposure limit.

(b) Wherever feasible engineering and work-practice controls which can be instituted immediately are not sufficient to reduce exposures to at or below the permissible exposure limit, they shall nonetheless be used to reduce exposures to the lowest practicable level, and shall be supplemented

by respiratory protection in accordance with subsection (7) of this section. A program shall be established and implemented to reduce exposures to at or below the permissible exposure limit, or to the greatest extent feasible, solely by means of engineering and work-practice controls, as soon as feasible.

(c) Written plans for such a program shall be developed and furnished upon request for examination and copying to the director. Such plans shall be updated at least every six months.

(7) **Respiratory protection.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this section.

(b) Respirator program. The employer must establish, implement, and maintain a respiratory protection program as required in chapter 296-62 WAC, Part E (except WAC 296-62-07130(1), 296-62-07131(4)(b)(i) and (ii), and 296-62-07150 through 296-62-07156).

(c) Respirator selection. Respirators must be selected from the following table:

Atmospheric concentration of Vinyl Chloride		Apparatus
(i)	Not over 10 ppm	Any chemical cartridge respirator with a vinyl chloride cartridge which provides a service life of at least 1 hour for concentrations of vinyl chloride up to 10 ppm.
(ii)	Not over 25 ppm	(A) A powered air-purifying respirator with hood, helmet, full or half facepiece, and a canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 ppm, or (B) Gas mask, front or back-mounted canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 ppm.
(iii)	Not over 100 ppm	Supplied air respirator demand type, with full facepiece.
(iv)	Not over 250 ppm	Type C, supplied air respirator, continuous flow type, with full or half facepiece, helmet or hood
(v)	Not over 3,600 ppm	Combination Type C supplied air respirator, pressure demand type, with full or half facepiece and auxiliary self-contained air supply.
(vi)	Unknown, or above 3,600 ppm	Open-circuit, self-contained breathing apparatus, pressure demand type, with full facepiece.

(d) Where air-purifying respirators are used:

(i) Air-purifying canisters or cartridges must be replaced prior to the expiration of their service life or the end of the shift in which they are first used, whichever occurs first, and

(ii) A continuous monitoring and alarm system must be provided when concentrations of vinyl chloride could reasonably exceed the allowable concentrations for the devices in use. Such system shall be used to alert employees when vinyl chloride concentrations exceed the allowable concentrations for the devices in use, and

(iii) Respirators specified for higher concentrations may be used for lower concentration.

WAC 296-62-07329 (Cont.)

(8) **Hazardous operations.**

(a) Employees engaged in hazardous operations, including entry of vessels to clean polyvinyl chloride residue from vessel walls, shall be provided and required to wear and use;

(i) Respiratory protection in accordance with subsections (3) and (7) of this section; and

(ii) Protective garments to prevent skin contact with liquid vinyl chloride or with polyvinyl chloride residue from vessel walls. The protective garments shall be selected for the operation and its possible exposure conditions.

(b) Protective garments shall be provided clean and dry for each use.

(c) Emergency situations. A written operational plan for emergency situations shall be developed for each facility storing, handling, or otherwise using vinyl chloride as a liquid or compressed gas. Appropriate portions of the plan shall be implemented in the event of an emergency. The plan shall specifically provide that:

(i) Employees engaged in hazardous operations or correcting situations of existing hazardous releases shall be equipped as required in subdivisions (a) and (b) of this subsection;

(ii) Other employees not so equipped shall evacuate the area and not return until conditions are controlled by the methods required in subsection (6) of this section and the emergency is abated.

(9) **Training.** Each employee engaged in vinyl chloride or polyvinyl chloride operations shall be provided training in a program relating to the hazards of vinyl chloride and precautions for its safe use.

(a) The program shall include:

(i) The nature of the health hazard from chronic exposure to vinyl chloride including specifically the carcinogenic hazard;

(ii) The specific nature of operations which could result in exposure to vinyl chloride in excess of the permissible limit and necessary protective steps;

(iii) The purpose for, proper use, and limitations of respiratory protective devices;

(iv) The fire hazard and acute toxicity of vinyl chloride, and the necessary protective steps;

(v) The purpose for and a description of the monitoring program;

(vi) The purpose for and a description of, the medical surveillance program;

(vii) Emergency procedures:

(A) Specific information to aid the employee in recognition of conditions which may result in the release of vinyl chloride; and

(B) A review of this standard at the employee's first training and indoctrination program, and annually thereafter.

WAC 296-62-07329 (Cont.)

(b) All materials relating to the program shall be provided upon request to the director.

(10) **Medical surveillance.** A program of medical surveillance shall be instituted for each employee exposed, without regard to the use of respirators, to vinyl chloride in excess of the action level. The program shall provide each such employee with an opportunity for examinations and tests in accordance with this subsection. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician and shall be provided without cost to the employee.

(a) At the time of initial assignment, or upon institution of medical surveillance;

(i) A general physical examination shall be performed with specific attention to detecting enlargement of liver, spleen or kidneys, or dysfunction in these organs, and for abnormalities in skin, connective tissues and the pulmonary system (see Appendix A).

(ii) A medical history shall be taken, including the following topics:

(A) Alcohol intake,

(B) Past history of hepatitis,

(C) Work history and past exposure to potential hepatotoxic agents, including drugs and chemicals,

(D) Past history of blood transfusions, and

(E) Past history of hospitalizations.

(iii) A serum specimen shall be obtained and determinations made of:

(A) Total bilirubin,

(B) Alkaline phosphatase,

(C) Serum glutamic oxalacetic transaminase (SGOT),

(D) Serum glutamic pyruvic transaminase (SGPT), and

(E) Gamma glustamyl transpeptidase.

(b) Examinations provided in accordance with this subdivision shall be performed at least:

(i) Every 6 months for each employee who has been employed in vinyl chloride or polyvinyl chloride manufacturing for 10 years or longer; and

(ii) Annually for all other employees.

(c) Each employee exposed to an emergency shall be afforded appropriate medical surveillance.

(d) A statement of each employee's suitability for continued exposure to vinyl chloride including use of protective equipment and respirators, shall be obtained from the examining physician promptly after any examination. A copy of the physician's statement shall be provided each employee.

(e) If any employee's health would be materially impaired by continued exposure, such employee shall be withdrawn from possible contact with vinyl chloride.

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(f) Laboratory analyses for all biological specimens included in medical examinations shall be performed in laboratories licensed under 42 CFR Part 74.

(g) If the examining physician determines that alternative medical examinations to those required by subdivision (a) of this subsection will provide at least equal assurance of detecting medical conditions pertinent to the exposure to vinyl chloride, the employer may accept such alternative examinations as meeting the requirements of subdivision (a) of this subsection, if the employer obtains a statement from the examining physician setting forth the alternative examinations and the rationale for substitution. This statement shall be available upon request for examination and copying to authorized representatives of the director.

(11) **Signs and labels.**

(a) Entrances to regulated areas shall be posted with legible signs bearing the legend:

CANCER-SUSPECT AGENT AREA AUTHORIZED PERSONNEL ONLY

(b) Areas containing hazardous operations or where an emergency currently exists shall be posted with legible signs bearing the legend:

CANCER-SUSPECT AGENT IN THIS AREA PROTECTIVE EQUIPMENT REQUIRED AUTHORIZED PERSONNEL ONLY

(c) Containers of polyvinyl chloride resin waste from reactors or other waste contaminated with vinyl chloride shall be legibly labeled:

CONTAMINATED WITH VINYL CHLORIDE CANCER-SUSPECT AGENT

(d) Containers of polyvinyl chloride shall be legibly labeled:

POLYVINYL CHLORIDE (OR TRADE NAME) CONTAINS VINYL CHLORIDE VINYL CHLORIDE IS A CANCER-SUSPECT AGENT

(e) Containers of vinyl chloride shall be legibly labeled either:

VINYL CHLORIDE EXTREMELY FLAMMABLE GAS UNDER PRESSURE CANCER-SUSPECT AGENT (or)

(f) In accordance with 49 CFR Part 173, Subpart H, with the additional legends:

CANCER-SUSPECT AGENT

Applied near the label or placard.

(g) No statement shall appear on or near any required sign, label or instruction which contradicts or detracts from the effect of any required warning, information or instruction.

(12) **Records.**

(a) All records maintained in accordance with this section shall include the name and social security number of each employee where relevant.

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(b) Records of required monitoring and measuring and medical records shall be provided upon request to employees, designated representatives, and the director in accordance with WAC 296-62-05201 through 296-62-05209; and 296-62-05213 through 296-62-05217. These records shall be provided upon request to the director. Authorized personnel rosters shall also be provided upon request to the director.

(i) Monitoring and measuring records shall:

(A) State the date of such monitoring and measuring and the concentrations determined and identify the instruments and methods used;

(B) Include any additional information necessary to determine individual employee exposures where such exposures are determined by means other than individual monitoring of employees; and

(C) Be maintained for not less than 30 years.

(ii) Medical records shall be maintained for the duration of the employment of each employee plus 20 years, or 30 years, whichever is longer.

(c) In the event that the employer ceases to do business and there is no successor to receive and retain his/her records for the prescribed period, these records shall be transmitted by registered mail to the director, and each employee individually notified in writing of this transfer. The employer shall also comply with any additional requirements set forth in WAC 296-62-05215.

(d) Employees or their designated representatives shall be provided access to examine and copy records of required monitoring and measuring.

(e) Former employees shall be provided access to examine and copy required monitoring and measuring records reflecting their own exposures.

(f) Upon written request of any employee, a copy of the medical record of that employee shall be furnished to any physician designated by the employee.

(13) **Reports.**

(a) Not later than 1 month after the establishment of a regulated area, the following information shall be reported to the director. Any changes to such information shall be reported within 15 days.

(i) The address and location of each establishment which has one or more regulated areas; and

(ii) The number of employees in each regulated area during normal operations, including maintenance.

(b) Emergencies and the facts obtainable at that time, shall be reported within 24 hours to the director. Upon request of the director, the employer shall submit additional information in writing relevant to the nature and extent of employee exposures and measures taken to prevent future emergencies of similar nature.

WAC 296-62-07329 (Cont.)

(c) Within 10 working days following any monitoring and measuring which discloses that any employee has been exposed, without regard to the use of respirators, in excess of the permissible exposure limit, each such employee shall be notified in writing of the results of the exposure measurement and the steps being taken to reduce the exposure to within the permissible exposure limit.

(14) **Appendix A supplementary medical information.**

APPENDIX A SUPPLEMENTARY MEDICAL INFORMATION

When required tests under subsection (10)(a) of this section show abnormalities, the tests should be repeated as soon as practicable, preferably within 3 to 4 weeks. If tests remain abnormal, consideration should be given to withdrawal of the employee from contact with vinyl chloride, while a more comprehensive examination is made.

Additional tests which may be useful:

(A) For kidney dysfunction: Urine examination for albumin, red blood cells, and exfoliative abnormal cells.

(B) Pulmonary system: Forced vital capacity, forced expiratory volume at 1 second, and chest roentgenogram (posterior-anterior, 14 x 17 inches).

(C) Additional serum tests: Lactic acid dehydrogenase, lactic acid dehydrogenase isoenzyme, protein determination, and protein electrophoresis.

(D) For a more comprehensive examination on repeated abnormal serum tests: Hepatitis B antigen, and liver scanning.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07329, filed 05/04/99, effective 09/01/99. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-62-07329, filed 7/20/94, effective 9/20/94; 91-03-044 (Order 90-18), § 296-62-07329, filed 1/10/91, effective 2/12/91. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-16-009 (Order 86-28), § 296-62-07329, filed 7/25/86; 82-13-045 (Order 82-22), § 296-62-07329, filed 6/11/82. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-07329, filed 8/27/81; 81-16-015 (Order 81-20), § 296-62-07329, filed 7/27/81; Order 75-41, § 296-62-07329, filed 12/19/75.]

WAC 296-62-07336 Acrylonitrile.

(1) **Scope and application.**

(a) This section applies to all occupational exposure to acrylonitrile (AN), Chemical Abstracts Service Registry No. 000107131, except as provided in (b) and (c) of this subsection.

(b) This section does not apply to exposures which result solely from the processing, use, and handling of the following materials:

(i) ABS resins, SAN resins, nitrile barrier resins, solid nitrile elastomers, and acrylic and modacrylic fibers, when these listed materials are in the form of finished polymers, and products fabricated from such finished polymers;

(ii) Materials made from and/or containing AN for which objective data is reasonably relied upon to demonstrate that the material is not capable of releasing AN in airborne concentrations in excess of 1 ppm as an eight-hour time-weighted average, under the expected conditions of processing, use, and handling which will cause the greatest possible release; and

WAC 296-62-07336 (Cont.)

(iii) Solid materials made from and/or containing AN which will not be heated above 170°F during handling, use, or processing.

(c) An employer relying upon exemption under (1)(b)(ii) shall maintain records of the objective data supporting that exemption, and of the basis of the employer's reliance on the data as provided in subsection (17) of this section.

(2) **Definitions**, as applicable to this section:

(a) **"Acrylonitrile" or "AN"** - acrylonitrile monomer, chemical formula CH2 = CHCN.

(b) **"Action level"** - a concentration of AN of 1 ppm as an eight-hour time-weighted average.

(c) **"Authorized person"** - any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees for the purpose of exercising the opportunity to observe monitoring procedures under subsection (18) of this section.

(d) **"Decontamination"** means treatment of materials and surfaces by water washdown, ventilation, or other means, to assure that the materials will not expose employees to airborne concentrations of AN above 1 ppm as an eight-hour time-weighted average.

(e) **"Director"** - the director of labor and industries, or his authorized representative.

(f) **"Emergency"** - any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which is likely to, or does, result in unexpected exposure to AN in excess of the ceiling limit.

(g) **"Liquid AN"** means AN monomer in liquid form, and liquid or semiliquid polymer intermediates, including slurries, suspensions, emulsions, and solutions, produced during the polymerization of AN.

(h) **"Polyacrylonitrile" or "PAN"** - polyacrylonitrile homopolymers or copolymers, except for materials as exempted under subsection (1)(b) of this section.

(3) **Permissible exposure limits.**

(a) Inhalation.

(i) Time-weighted average limit (TWA). The employer shall assure that no employee is exposed to an airborne concentration of acrylonitrile in excess of two parts acrylonitrile per million parts of air (2 ppm), as an eight-hour time-weighted average.

(ii) Ceiling limit. The employer shall assure that no employee is exposed to an airborne concentration of acrylonitrile in excess of 10 ppm as averaged over any fifteen-minute period during the working day.

(b) Dermal and eye exposure. The employer shall assure that no employee is exposed to skin contact or eye contact with liquid AN or PAN.

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(4) **Notification of use and emergencies.**

(a) Use. Within ten days of the effective date of this standard, or within fifteen days following the introduction of AN into the workplace, every employer shall report, unless he has done so pursuant to the emergency temporary standard, the following information to the director for each such workplace:

(i) The address and location of each workplace in which AN is present;

(ii) A brief description of each process of operation which may result in employee exposure to AN;

(iii) The number of employees engaged in each process or operation who may be exposed to AN and an estimate of the frequency and degree of exposure that occurs; and

(iv) A brief description of the employer's safety and health program as it relates to limitation of employee exposure to AN. Whenever there has been a significant change in the information required by this subsection, the employer shall promptly amend such information previously provided to the director.

(b) Emergencies and remedial action. Emergencies, and the facts obtainable at that time, shall be reported within 24 hours of the initial occurrence to the director. Upon request of the director, the employer shall submit additional information in writing relevant to the nature and extent of employee exposures and measures taken to prevent future emergencies of a similar nature.

(5) **Exposure monitoring.**

(a) General.

(i) Determinations of airborne exposure levels shall be made from air samples that are representative of each employee's exposure to AN over an eight-hour period.

(ii) For the purposes of this section, employee exposure is that which would occur if the employee were not using a respirator.

(b) Initial monitoring. Each employer who has a place of employment in which AN is present shall monitor each such workplace and work operation to accurately determine the airborne concentrations of AN to which employees may be exposed. Such monitoring may be done on a representative basis, provided that the employer can demonstrate that the determinations are representative of employee exposures.

(c) Frequency.

(i) If the monitoring required by this section reveals employee exposure to be below the action level, the employer may discontinue monitoring for that employee. The employer shall continue these quarterly measurements until at least two consecutive measurements taken at least seven days apart, are below the action level, and thereafter the employer may discontinue monitoring for that employee.

(ii) If the monitoring required by this section reveals employee exposure to be at or above the action level but below the permissible exposure limits, the employer shall repeat such monitoring for each such employee at least quarterly.

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(iii) If the monitoring required by this section reveals employee exposure to be in excess of the permissible exposure limits, the employer shall repeat these determinations for each such employee at least monthly. The employer shall continue these monthly measurements until at least two consecutive measurements, taken at least seven days apart, are below the permissible exposure limits, and thereafter the employer shall monitor at least quarterly.

(d) Additional monitoring. Whenever there has been a production, process, control or personnel change which may result in new or additional exposure to AN, or whenever the employer has any other reason to suspect a change which may result in new or additional exposures to AN, additional monitoring which complies with this subsection shall be conducted.

(e) Employee notification.

(i) Within five working days after the receipt of monitoring results, the employer shall notify each employee in writing of the results which represent that employee's exposure.

(ii) Whenever the results indicate that the representative employee exposure exceeds the permissible exposure limits, the employer shall include in the written notice a statement that the permissible exposure limits were exceeded and a description of the corrective action being taken to reduce exposure to or below the permissible exposure limits.

(f) Accuracy of measurement. The method of measurement of employee exposures shall be accurate, to a confidence level of 95 percent, to within plus or minus 25 percent for concentrations of AN at or above the permissible exposure limits, and plus or minus 35 percent for concentrations of AN between the action level and the permissible exposure limits.

(g) Weekly survey of operations involving liquid AN. In addition to monitoring of employee exposures to AN as otherwise required by this subsection, the employer shall survey areas of operations involving liquid AN at least weekly to detect points where AN liquid or vapor are being released into the workplace. The survey shall employ an infra-red gas analyzer calibrated for AN, a multipoint gas chromatographic monitor, or comparable system for detection of AN. A listing of levels detected and areas of AN release, as determined from the survey, shall be posted prominently in the workplace, and shall remain posted until the next survey is completed.

(6) **Regulated areas.**

(a) The employer shall establish regulated areas where AN concentrations are in excess of the permissible exposure limits.

(b) Regulated areas shall be demarcated and segregated from the rest of the workplace, in any manner that minimizes the number of persons who will be exposed to AN.

(c) Access to regulated areas shall be limited to authorized persons or to persons otherwise authorized by the act or regulations issued pursuant thereto.

(d) The employer shall assure that in the regulated area, food or beverages are not present or consumed, smoking products are not present or used, and cosmetics are not applied, (except that these activities may be conducted in the lunchrooms, change rooms and showers required under subsections (13)(a)-(13)(c) of this section.

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(7) **Methods of compliance.**

(a) Engineering and work-practice controls.

(i) The employer shall institute engineering or work-practice controls to reduce and maintain employee exposures to AN, to or below the permissible exposure limits, except to the extent that the employer establishes that such controls are not feasible.

(ii) Wherever the engineering and work-practice controls which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limits, the employer shall nonetheless use them to reduce exposures to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of subsection (8) of this section.

(b) Compliance program.

(i) The employer shall establish and implement a written program to reduce employee exposures to or below the permissible exposure limits solely by means of engineering and work-practice controls, as required by subsection (7)(a) of this section.

(ii) Written plans for these compliance programs shall include at least the following:

(A) A description of each operation or process resulting in employee exposure to AN above the permissible exposure limits;

(B) Engineering plans and other studies used to determine the controls for each process;

(C) A report of the technology considered in meeting the permissible exposure limits;

(D) A detailed schedule for the implementation of engineering or work-practice controls; and

(E) Other relevant information.

(iii) The employer shall complete the steps set forth in the compliance program by the dates in the schedule.

(iv) Written plans for such a program shall be submitted upon request to the director, and shall be available at the worksite for examination and copying by the director, or any affected employee or representative.

(v) The plans required by this subsection shall be revised and updated at least every six months to reflect the current status of the program.

(8) **Respiratory protection.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls;

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(ii) Work operations, such as maintenance and repair activities or reactor cleaning, for which the employer establishes that engineering and work-practice controls are not feasible;

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limits;

(iv) Emergencies.

(b) Respirator program. The employer must implement a respiratory protection program in accordance with chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(c) Respirator selection. The employer must select the appropriate respirator from Table I of this subsection.

TABLE I

RESPIRATORY PROTECTION FOR ACRYLONITRILE (AN)

Concentration of AN or Condition of Use		Respirator Type	
(a)	Less than or equal to 25 x permissible exposure limits.	(i)	Any Type C supplied-air respirator
(b)	Less than or equal to 100 x permissible exposure limits.	(i)	Any supplied-air respirator with full facepiece, or
		(ii)	Any self-contained breathing apparatus with full facepiece.
(c)	Less than or equal to 250 x permissible exposure limits.	(i)	Supplied-air respirator in positive-pressure mode with full facepiece, helmet, hood, or suit.
(d)	Greater than 250 x permissible exposure limits.	(i)	supplied-air respirator with full facepiece and an auxiliary self-contained air supply, operated in pressure-demand mode; or
		(ii)	Open circuit self-contained breathing apparatus with full facepiece in positive-pressure mode.
(e)	Emergency entry into unknown concentration or firefighting.	(i)	Any self-contained breathing apparatus with full facepiece in positive-pressure mode.
(f)	Escape.	(i)	Any organic vapor gas mask; or
		(ii)	Any self-contained breathing.

(9) **Emergency situations.**

(a) Written plans.

(i) A written plan for emergency situations shall be developed for each workplace where AN is present. Appropriate portions of the plan shall be implemented in the event of an emergency.

(ii) The plan shall specifically provide that employees engaged in correcting emergency conditions shall be equipped as required in subsection (8) of this section until the emergency is abated.

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(b) Alerting employees.

(i) Where there is the possibility of employee exposure to AN in excess of the ceiling limit due to the occurrence of an emergency, a general alarm shall be installed and maintained to promptly alert employees of such occurrences.

(ii) Employees not engaged in correcting the emergency shall be evacuated from the area and shall not be permitted to return until the emergency is abated.

(10) **Protective clothing and equipment.**

(a) Provision and use. Where eye or skin contact with liquid AN or PAN may occur, the employer shall provide at no cost to the employee, and assure that employees wear, appropriate protective clothing or other equipment in accordance with WAC 296-800-160 to protect any area of the body which may come in contact with liquid AN or PAN.

(b) Cleaning and replacement.

(i) The employer shall clean, launder, maintain, or replace protective clothing and equipment required by this subsection, as needed to maintain their effectiveness.

In addition, the employer shall provide clean protective clothing and equipment at least weekly to each affected employee.

(ii) The employer shall assure that impermeable protective clothing which contacts or is likely to have contacted liquid AN shall be decontaminated before being removed by the employee.

(iii) The employer shall assure that AN- or PAN-contaminated protective clothing and equipment is placed and stored in closable containers which prevent dispersion of the AN or PAN outside the container.

(iv) The employer shall assure that an employee whose nonimpermeable clothing becomes wetted with liquid AN shall immediately remove that clothing and proceed to shower. The clothing shall be decontaminated before it is removed from the regulated area.

(v) The employer shall assure that no employee removes AN- or PAN-contaminated protective equipment or clothing from the change room, except for those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(vi) The employer shall inform any person who launders or cleans AN-or PAN-contaminated protective clothing or equipment of the potentially harmful effects of exposure to AN.

(vii) The employer shall assure that containers of contaminated protective clothing and equipment which are to be removed from the workplace for any reason are labeled in accordance with subsection (16)(c)(ii) of this section, and that such labels remain affixed when such containers leave the employer's workplace.

(11) **Housekeeping.**

(a) All surfaces shall be maintained free of accumulations of liquid AN and of PAN.

(b) For operations involving liquid AN, the employer shall institute a program for detecting leaks and spills of liquid AN, including regular visual inspections.

WAC 296-62-07336 (Cont.)

(c) Where spills of liquid AN are detected, the employer shall assure that surfaces contacted by the liquid AN are decontaminated. Employees not engaged in decontamination activities shall leave the area of the spill, and shall not be permitted in the area until decontamination is completed.

(d) Liquids. Where AN is present in a liquid form, or as a resultant vapor, all containers or vessels containing AN shall be enclosed to the maximum extent feasible and tightly covered when not in use, with adequate provision made to avoid any resulting potential explosion hazard.

(e) Surfaces.

(i) Dry sweeping and the use of compressed air for the cleaning of floors and other surfaces where AN and PAN are found is prohibited.

(ii) Where vacuuming methods are selected, either portable units or a permanent system may be used.

(A) If a portable unit is selected, the exhaust shall be attached to the general workplace exhaust ventilation system or collected within the vacuum unit, equipped with high efficiency filters or other appropriate means of contaminant removal, so that AN is not reintroduced into the workplace air; and

(B) Portable vacuum units used to collect AN may not be used for other cleaning purposes and shall be labeled as prescribed by subsection (16)(c)(ii) of this section.

(iii) Cleaning of floors and other contaminated surfaces may not be performed by washing down with a hose, unless a fine spray has first been laid down.

(12) **Waste disposal.** AN and PAN waste, scrap, debris, bags, containers or equipment, shall be disposed of in sealed bags or other closed containers which prevent dispersion of AN outside the container, and labeled as prescribed in subsection (16)(c)(ii) of this section.

(13) **Hygiene facilities and practices.** Where employees are exposed to airborne concentrations of AN above the permissible exposure limits, or where employees are required to wear protective clothing or equipment pursuant to subsection (11) of this section, or where otherwise found to be appropriate, the facilities required by WAC 296-24-12009 and 296-800-230 shall be provided by the employer for the use of those employees, and the employer shall assure that the employees use the facilities provided. In addition, the following facilities or requirements are mandated.

(a) Change rooms. The employer shall provide clean change rooms in accordance with WAC 296-24-12011.

(b) Showers.

(i) The employer shall provide shower facilities in accordance with WAC 296-24-12009(3).

(ii) In addition, the employer shall also assure that employees exposed to liquid AN and PAN shower at the end of the work shift.

(iii) The employer shall assure that, in the event of skin or eye exposure to liquid AN, the affected employee shall shower immediately to minimize the danger of skin absorption.

WAC 296-62-07336 (Cont.)

(c) Lunchrooms.

(i) Whenever food or beverages are consumed in the workplace, the employer shall provide lunchroom facilities which have a temperature controlled, positive pressure, filtered air supply, and which are readily accessible to employees exposed to AN above the permissible exposure limits.

(ii) In addition, the employer shall also assure that employees exposed to AN above the permissible exposure limits wash their hands and face prior to eating.

(14) **Medical surveillance.**

(a) General.

(i) The employer shall institute a program of medical surveillance for each employee who is or will be exposed to AN above the action level. The employer shall provide each such employee with an opportunity for medical examinations and tests in accordance with this subsection.

(ii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee.

(b) Initial examinations. At the time of initial assignment, or upon institution of the medical surveillance program, the employer shall provide each affected employee an opportunity for a medical examination, including at least the following elements:

(i) A work history and medical history with special attention to skin, respiratory, and gastrointestinal systems, and those non-specific symptoms, such as headache, nausea, vomiting, dizziness, weakness, or other central nervous system dysfunctions that may be associated with acute or chronic exposure to AN.

(ii) A physical examination giving particular attention to central nervous system, gastrointestinal system, respiratory system, skin and thyroid.

(iii) A “14 x 17” posteroanterior chest x-ray.

(iv) Further tests of the intestinal tract, including fecal occult blood screening, and proctosigmoidoscopy, for all workers 40 years of age or older, and for any other affected employees for whom, in the opinion of the physician, such testing is appropriate.

(c) Periodic examinations.

(i) The employer shall provide examinations specified in this subsection at least annually for all employees specified in subsection (14)(a) of this section.

(ii) If an employee has not had the examinations prescribed in subsection (14)(b) of this section within six months of termination of employment, the employer shall make such examination available to the employee upon such termination.

(d) Additional examinations. If the employee for any reason develops signs or symptoms commonly associated with exposure to AN, the employer shall provide appropriate examination and emergency medical treatment.

WAC 296-62-07336 (Cont.)

(e) Information provided to the physician. The employer shall provide the following information to the examining physician:

(i) A copy of this standard and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's representative exposure level;

(iv) The employee's anticipated or estimated exposure level (for preplacement examinations or in cases of exposure due to an emergency);

(v) A description of any personal protective equipment used or to be used; and

(vi) Information from previous medical examinations of the affected employee, which is not otherwise available to the examining physician.

(f) Physician's written opinion.

(i) The employer shall obtain a written opinion from the examining physician which shall include:

(A) The results of the medical examination and test performed;

(B) The physician's opinion as to whether the employee has any detected medical condition which would place the employee at an increased risk of material impairment of the employee's health from exposure to AN;

(C) Any recommended limitations upon the employee's exposure to AN or upon the use of protective clothing and equipment such as respirators; and

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The employer shall instruct the physician not to reveal in the written opinion specific findings or diagnoses unrelated to occupational exposure to AN.

(iii) The employer shall provide a copy of the written opinion to the affected employee.

(15) **Employee information and training.**

(a) Training program.

(i) The employer shall institute a training program for all employees where there is occupational exposure to AN and shall assure their participation in the training program.

(ii) The training program shall be provided at the time of initial assignment, or upon institution of the training program, and at least annually thereafter, and the employer shall assure that each employee is informed of the following:

(A) The information contained in Appendices A, B and C;

WAC 296-62-07336 (Cont.)

(B) The quantity, location, manner of use, release or storage of AN and the specific nature of operations which could result in exposure to AN, as well as any necessary protective steps;

(C) The purpose, proper use, and limitations of respirators and protective clothing;

(D) The purpose and a description of the medical surveillance program required by subsection (14) of this section;

(E) The emergency procedures developed, as required by subsection (9) of this section; and

(F) The engineering and work-practice controls, their function and the employee's relationship thereto; and

(G) A review of this standard.

(b) Access to training materials.

(i) The employer shall make a copy of this standard and its appendices readily available to all affected employees.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to the director.

(16) **Signs and labels.**

(a) General.

(i) The employer may use labels or signs required by other statutes, regulations, or ordinances in addition to, or in combination with, signs and labels required by this subsection.

(ii) The employer shall assure that no statement appears on or near any sign or label, required by this subsection, which contradicts or detracts from such effects of the required sign or label.

(b) Signs.

(i) The employer shall post signs to clearly indicate all workplaces where AN concentrations exceed the permissible exposure limits. The signs shall bear the following legend:

DANGER
ACRYLONITRILE (AN)
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS REQUIRED

(ii) The employer shall assure that signs required by this subsection are illuminated and cleaned as necessary so that the legend is readily visible.

(c) Labels.

WAC 296-62-07336 (Cont.)

(i) The employer shall assure that precautionary labels are affixed to all containers of AN, and to containers of PAN and products fabricated from PAN, except for those materials for which objective data is provided as to the conditions specified in subsection (1)(b) of this section. The employer shall assure that the labels remain affixed when the AN or PAN are sold, distributed or otherwise leave the employer's workplace.

(ii) The employer shall assure that the precautionary labels required by this subsection are readily visible and legible. The labels shall bear the following legend:

DANGER
CONTAINS ACRYLONITRILE (AN)
CANCER HAZARD

(17) **Recordkeeping.**

(a) Objective data for exempted operations.

(i) Where the processing, use, and handling of products fabricated from PAN are exempted pursuant to subsection (1)(b) of this section, the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(ii) This record shall include the following information:

(A) The relevant condition in subsection (1)(b) upon which exemption is based;

(B) The source of the objective data;

(C) The testing protocol, results of testing, and/or analysis of the material for the release of AN;

(D) A description of the operation exempted and how the data supports the exemption; and

(E) Other data relevant to the operations, materials, and processing covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(b) Exposure monitoring.

(i) The employer shall establish and maintain an accurate record of all monitoring required by subsection (5) of this section.

(ii) This record shall include:

(A) The dates, number, duration, and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure;

(B) A description of the sampling and analytical methods used and the data relied upon to establish that the methods used meet the accuracy and precision requirements of subsection (5)(f) of this section;

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(C) Type of respiratory protective devices worn, if any; and

(D) Name, social security number and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent.

(iii) The employer shall maintain this record for at least 40 years or the duration of employment plus 20 years, whichever is longer.

(c) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by subsection (14) of this section.

(ii) This record shall include:

(A) A copy of the physicians' written opinions;

(B) Any employee medical complaints related to exposure to AN;

(C) A copy of the information provided to the physician as required by subsection (14)(f) of this section; and

(D) A copy of the employee's medical and work history.

(iii) The employer shall assure that this record be maintained for at least forty years or for the duration of employment plus twenty years, whichever is longer.

(d) Availability.

(i) The employer shall assure that all records required to be maintained by this section be made available upon request to the director for examination and copying.

(ii) Records required by subdivisions (a) through (c) of this subsection shall be provided upon request to employees, designated representatives, and the assistant director in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217. Records required by subdivision (a) of this section shall be provided in the same manner as exposure monitoring records.

(iii) The employer shall assure that employee medical records required to be maintained by this section, be made available, upon request, for examination and copying, to the affected employee or former employee, or to a physician designated by the affected employee, former employee, or designated representative.

(e) Transfer of records.

(i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by this section.

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, these records shall be transmitted to the director.

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(iii) At the expiration of the retention period for the records required to be maintained pursuant to this section, the employer shall transmit these records to the director.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in WAC 296-62-05215.

(18) **Observation of monitoring.**

(a) Employee observation. The employer shall provide affected employees, or their designated representatives, an opportunity to observe any monitoring of employee exposure to AN conducted pursuant to subsection (5) of this section.

(b) Observation procedures.

(i) Whenever observation of the monitoring of employee exposure to AN requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the observer with personal protective clothing or equipment required to be worn by employees working in the area, assure the use of such clothing and equipment, and require the observer to comply with all other applicable safety and health procedures.

(ii) Without interfering with the monitoring, observers shall be entitled:

(A) To receive an explanation of the measurement procedures;

(B) To observe all steps related to the measurement of airborne concentrations of AN performed at the place of exposure; and

(C) To record the results obtained.

(19) **Appendices.** The information contained in the appendices is not intended, by itself, to create any additional obligation not otherwise imposed, or to detract from any obligation.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07336, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07336, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 88-11-021 (Order 88-04), § 296-62-07336, filed 5/11/88.]

WAC 296-62-07337 Appendix A--Substance safety data sheet for acrylonitrile.

(1) **Substance identification.**

(a) Substance: Acrylonitrile (CH2 CHCN).

(b) Synonyms: Propenenitrile; vinyl cyanide; cyanoethylene; AN; VCN; acylon; carbacryl; fumigrian; ventox.

(c) Acrylonitrile can be found as a liquid or vapor, and can also be found in polymer resins, rubbers, plastics, polyols, and other polymers having acrylonitrile as a raw or intermediate material.

(d) AN is used in the manufacture of acrylic and modiacrylic fibers, acrylic plastics and resins, speciality polymers, nitrile rubbers, and other organic chemicals. It has also been used as a fumigant.

(e) Appearance and odor: Colorless to pale yellow liquid with a pungent odor which can only be detected at concentrations above the permissible exposure level, in a range of 13-19 parts AN per million parts of air (13-19 ppm).

(f) Permissible exposure: Exposure may not exceed either:

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(i) Two parts AN per million parts of air (2 ppm) averaged over the eight-hour workday; or

(ii) Ten parts AN per million parts of air (10 ppm) averaged over any fifteen-minute period in the workday.

(iii) In addition, skin and eye contact with liquid AN is prohibited.

(2) **Health hazard data.**

(a) Acrylonitrile can affect your body if you inhale the vapor (breathing), if it comes in contact with your eyes or skin, or if you swallow it. It may enter your body through your skin.

(b) Effects of overexposure:

(i) Short-term exposure: Acrylonitrile can cause eye irritation, nausea, vomiting, headache, sneezing, weakness, and light-headedness. At high concentrations, the effects of exposure may go on to loss of consciousness and death. When acrylonitrile is held in contact with the skin after being absorbed into shoe leather or clothing, it may produce blisters following several hours of no apparent effect. Unless the shoes or clothing are removed immediately and the area washed, blistering will occur. Usually there is no pain or inflammation associated with blister formation.

(ii) Long-term exposure: Acrylonitrile has been shown to cause cancer in laboratory animals and has been associated with higher incidences of cancer in humans. Repeated or prolonged exposure of the skin to acrylonitrile may produce irritation and dermatitis.

(iii) Reporting signs and symptoms: You should inform your employer if you develop any signs or symptoms and suspect they are caused by exposure to acrylonitrile.

(3) **Emergency first aid procedures.**

(a) Eye exposure: If acrylonitrile gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

(b) Skin exposure: If acrylonitrile gets on your skin, immediately wash the contaminated skin with water. If acrylonitrile soaks through your clothing, especially your shoes, remove the clothing immediately and wash the skin with water. If symptoms occur after washing, get medical attention immediately. Thoroughly wash the clothing before reusing. Contaminated leather shoes or other leather articles should be discarded.

(c) Inhalation: If you or any other person breathes in large amounts of acrylonitrile, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

(d) Swallowing: When acrylonitrile has been swallowed, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

(e) Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the location of the emergency equipment before the need arises.

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(f) Special first aid procedures: First aid kits containing an adequate supply (at least two dozen) of amyl nitrite pearls, each containing 0.3 ml, should be maintained at each site where acrylonitrile is used. When a person is suspected of receiving an overexposure to acrylonitrile, immediately remove that person from the contaminated area using established rescue procedures. Contaminated clothing must be removed and the acrylonitrile washed from the skin immediately. Artificial respiration should be started at once if breathing has stopped. If the person is unconscious, amyl nitrite may be used as an antidote by a properly trained individual in accordance with established emergency procedures. Medical aid should be obtained immediately.

(4) **Respirators and protective clothing.**

(a) Respirators: You may be required to wear a respirator for nonroutine activities, in emergencies, while your employer is in the process of reducing acrylonitrile exposures through engineering controls, and in areas where engineering controls are not feasible. If respirators are worn, they must have a label issued by the National Institute for Occupational Safety and Health under the provisions of 42 CFR part 84 stating that the respirators have been certified for use with organic vapors. For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required.

(b) Supplied-air suits: In some work situations, the wearing of supplied-air suits may be necessary. Your employer must instruct you in their proper use and operation.

(c) Protective clothing:

(i) You must wear impervious clothing, gloves, face shield, or other appropriate protective clothing to prevent skin contact with liquid acrylonitrile. Where protective clothing is required, your employer is required to provide clean garments to you as necessary to assume that the clothing protects you adequately.

(ii) Replace or repair impervious clothing that has developed leaks.

(iii) Acrylonitrile should never be allowed to remain on the skin. Clothing and shoes which are not impervious to acrylonitrile should not be allowed to become contaminated with acrylonitrile, and if they do the clothing and shoes should be promptly removed and decontaminated. The clothing should be laundered or discarded after the AN is removed. Once acrylonitrile penetrates shoes or other leather articles, they should not be worn again.

(d) Eye protection: You must wear splashproof safety goggles in areas where liquid acrylonitrile may contact your eyes. In addition, contact lenses should not be worn in areas where eye contact with acrylonitrile can occur.

(5) **Precautions for safe use, handling, and storage.**

(a) Acrylonitrile is a flammable liquid, and its vapors can easily form explosive mixtures in air.

(b) Acrylonitrile must be stored in tightly closed containers in a cool, well-ventilated area, away from heat, sparks, flames, strong oxidizers (especially bromine), strong bases, copper, copper alloys, ammonia, and amines.

(c) Sources of ignition such as smoking and open flames are prohibited wherever acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard.

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(d) You should use nonsparking tools when opening or closing metal containers of acrylonitrile, and containers must be bonded and grounded when pouring or transferring liquid acrylonitrile.

(e) You must immediately remove any nonimpervious clothing that becomes wetted with acrylonitrile, and this clothing must not be reworn until the acrylonitrile is removed from the clothing.

(f) Impervious clothing wet with liquid acrylonitrile can be easily ignited. This clothing must be washed down with water before you remove it.

(g) If your skin becomes wet with liquid acrylonitrile, you must promptly and thoroughly wash or shower with soap or mild detergent to remove any acrylonitrile from your skin.

(h) You must not keep food, beverages, or smoking materials, nor are you permitted to eat or smoke in regulated areas where acrylonitrile concentrations are above the permissible exposure limits.

(i) If you contact liquid acrylonitrile, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

(j) Fire extinguishers and quick drenching facilities must be readily available, and you should know where they are and how to operate them.

(k) Ask your supervisor where acrylonitrile is used in your work area and for any additional plant safety and health rules.

(6) **Access to information.**

(a) Each year, your employer is required to inform you of the information contained in this Substance Safety Data Sheet for acrylonitrile. In addition, your employer must instruct you in the proper work-practices for using acrylonitrile, emergency procedures, and the correct use of protective equipment.

(b) Your employer is required to determine whether you are being exposed to acrylonitrile. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being overexposed, he or she is required to inform you of the actions which are being taken to reduce your exposure to within permissible exposure limits.

(c) Your employer is required to keep records of your exposures and medical examinations. These records must be kept by the employer for at least forty years or for the period of your employment plus twenty years, whichever is longer.

(d) Your employer is required to release your exposure and medical records to you or your representative upon your request.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07337, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-62-07337, filed 7/20/94, effective 9/20/94; 88-11-021 (Order 88-04), § 296-62-07337, filed 5/11/88.]

WAC 296-62-07338 Appendix B--Substance technical guidelines for acrylonitrile.

(1) **Physical and chemical data.**

(a) Substance identification:

(i) Synonyms: AN; VCN; vinyl cyanide; propenenitrile; cyanoethylene; Acrylon; Carbacryl; Fumigrain; Ventox.

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(ii) Formula: $CH_2 = CHCN$.

(iii) Molecular weight: 53.1.

(b) Physical data:

(i) Boiling point (760 mm Hg): 77.3°C (171°F);

(ii) Specific gravity (water = 1): 0.81 (at 20°C or 68°F);

(iii) Vapor density (air = 1 at boiling point of acrylonitrile): 1.83;

(iv) Melting point: -83°C (-117°F);

(v) Vapor pressure (@20°F): 83 mm Hg;

(vi) Solubility in water, percent by weight @20°C (68°F): 7.35;

(vii) Evaporation rate (Butyl Acetate = 1): 4.54; and

(viii) Appearance and odor: Colorless to pale yellow liquid with a pungent odor at concentrations above the permissible exposure level. Any detectable odor of acrylonitrile may indicate overexposure.

(2) **Fire, explosion, and reactivity hazard data.**

(a) Fire:

(i) Flash point: -1°C (30°F) (closed cup).

(ii) Autoignition temperature: 481°C (898°F).

(iii) Flammable limits air, percent by volume: Lower: 3, Upper: 17.

(iv) Extinguishing media: Alcohol foam, carbon dioxide, and dry chemical.

(v) Special fire-fighting procedures: Do not use a solid stream of water, since the stream will scatter and spread the fire. Use water to cool containers exposed to a fire.

(vi) Unusual fire and explosion hazards: Acrylonitrile is a flammable liquid. Its vapors can easily form explosive mixtures with air. All ignition sources must be controlled where acrylonitrile is handled, used, or stored in a manner that could create a potential fire or explosion hazard. Acrylonitrile vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which acrylonitrile is being handled.

(vii) For purposes of compliance with the requirements of WAC 296-800-300, acrylonitrile is classified as a Class IB flammable liquid. For example, 7,500 ppm, approximately one-fourth of the lower flammable limit, would be considered to pose a potential fire and explosion hazard.

(viii) For purposes of compliance with WAC 296-24-59207, acrylonitrile is classified as a Class B fire hazard.

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(ix) For purpose of compliance with WAC 296-24-95613, locations classified as hazardous due to the presence of acrylonitrile shall be Class I, Group D.

(b) Reactivity:

(i) Conditions contributing to instability: Acrylonitrile will polymerize when hot, and the additional heat liberated by the polymerization may cause containers to explode. Pure AN may self-polymerize, with a rapid build-up of pressure, resulting in an explosion hazard. Inhibitors are added to the commercial product to prevent self-polymerization.

(ii) Incompatibilities: Contact with strong oxidizers (especially bromine) and strong bases may cause fires and explosions. Contact with copper, copper alloys, ammonia, and amines may start serious decomposition.

(iii) Hazardous decomposition products: Toxic gases and vapors (such as hydrogen cyanide, oxides of nitrogen, and carbon monoxide) may be released in a fire involving acrylonitrile and certain polymers made from acrylonitrile.

(iv) Special precautions: Liquid acrylonitrile will attack some forms of plastics, rubbers, and coatings.

(3) **Spill, leak, and disposal procedures.**

(a) If acrylonitrile is spilled or leaked, the following steps should be taken:

(i) Remove all ignition sources.

(ii) The area should be evacuated at once and re-entered only after the area has been thoroughly ventilated and washed down with water.

(iii) If liquid acrylonitrile or polymer intermediate, collect for reclamation or absorb in paper, vermiculite, dry sand, earth, or similar material, or wash down with water into process sewer system.

(b) Persons not wearing protective equipment should be restricted from areas of spills or leaks until clean-up has been completed.

(c) Waste disposal methods: Waste materials shall be disposed of in a manner that is not hazardous to employees or to the general population. Spills of acrylonitrile and flushing of such spills shall be channeled for appropriate treatment or collection for disposal. They shall not be channeled directly into the sanitary sewer system. In selecting the method of waste disposal, applicable local, state, and federal regulations should be consulted.

(4) **Monitoring and measurement procedures.**

(a) Exposure above the permissible exposure limit:

(i) Eight-hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken so that the average eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples.

Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

(ii) Ceiling evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of acrylonitrile in the employee's breathing zone. A minimum of three measurements should be taken on one work shift. The average of all measurements taken is an estimate of the employee's ceiling exposure.

(iii) Monitoring techniques: The sampling and analysis under this section may be performed by collecting the acrylonitrile vapor on charcoal adsorption tubes or other composition adsorption tubes, with subsequent chemical analysis. Sampling and analysis may also be performed by instruments such as real-time continuous monitoring systems, portable direct-reading instruments, or passive dosimeters. Analysis of resultant samples should be by gas chromatograph.

(iv) Appendix D lists methods of sampling and analysis which have been tested by NIOSH and OSHA for use with acrylonitrile. NIOSH and OSHA have validated modifications of NIOSH Method S-156 (see Appendix D) under laboratory conditions for concentrations below 1 ppm. The employer has the obligation of selecting a monitoring method which meets the accuracy and precision requirements of the standard under his/her unique field conditions. The standard requires that methods of monitoring must be accurate, to a 95-percent confidence level, to ±35-percent for concentrations of AN at or above 2 ppm, and to ±50-percent for concentrations below 2 ppm. In addition to the methods described in Appendix D, there are numerous other methods available for monitoring for AN in the workplace. Details on these other methods have been submitted by various companies to the rulemaking record, and are available at the OSHA Docket Office.

(b) Since many of the duties relating to employee exposure are dependent on the results of monitoring and measuring procedures, employers shall assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

(5) **Protective clothing.**

(a) Employees shall be provided with and required to wear appropriate protective clothing to prevent any possibility of skin contact with liquid AN. Because acrylonitrile is absorbed through the skin, it is important to prevent skin contact with liquid AN. Protective clothing shall include impermeable coveralls or similar full-body work clothing, gloves, head-coverings, as appropriate to protect areas of the body which may come in contact with liquid AN.

(b) Employers should ascertain that the protective garments are impermeable to acrylonitrile. Nonimpermeable clothing and shoes should not be allowed to become contaminated with liquid AN. If permeable clothing does become contaminated, it should be promptly removed, placed in a regulated area for removal of the AN, and not worn again until the AN is removed. If leather footwear or other leather garments become wet from acrylonitrile, they should be replaced and not worn again, due to the ability of leather to absorb acrylonitrile and hold it against the skin. Since there is no pain associated with the blistering which may result from skin contact with liquid AN, it is essential that the employee be informed of this hazard so that he or she can be protected.

(c) Any protective clothing which has developed leaks or is otherwise found to be defective shall be repaired or replaced. Clean protective clothing shall be provided to the employee as necessary to assure its protectiveness. Whenever impervious clothing becomes wet with liquid AN, it shall be washed down with water before being removed by the employee. Employees are also required to wear splash-proof safety goggles where there is any possibility of acrylonitrile contacting the eyes.

(6) **Housekeeping and hygiene facilities.** For purposes of complying with WAC 296-24-120, 296-800-220 and 296-800-230, the following items should be emphasized:

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(a) The workplace should be kept clean, orderly, and in a sanitary condition. The employer is required to institute a leak and spill detection program for operations involving liquid AN in order to detect sources of fugitive AN emissions.

(b) Dry sweeping and the use of compressed air is unsafe for the cleaning of floors and other surfaces where liquid AN may be found.

(c) Adequate washing facilities with hot and cold water are to be provided, and maintained in a sanitary condition. Suitable cleansing agents are also to be provided to assure the effective removal of acrylonitrile from the skin.

(d) Change or dressing rooms with individual clothes storage facilities must be provided to prevent the contamination of street clothes with acrylonitrile. Because of the hazardous nature of acrylonitrile, contaminated protective clothing should be placed in a regulated area designated by the employer for removal of the AN before the clothing is laundered or disposed of.

(7) **Miscellaneous precautions.**

(a) Store acrylonitrile in tightly-closed containers in a cool, well-ventilated area and take necessary precautions to avoid any explosion hazard.

(b) High exposures to acrylonitrile can occur when transferring the liquid from one container to another.

(c) Nonsparking tools must be used to open and close metal acrylonitrile containers. These containers must be effectively grounded and bonded prior to pouring.

(d) Never store uninhibited acrylonitrile.

(e) Acrylonitrile vapors are not inhibited.

They may form polymers and clog vents of storage tanks.

(f) Use of supplied-air suits or other impervious coverings may be necessary to prevent skin contact with and provide respiratory protection from acrylonitrile where the concentration of acrylonitrile is unknown or is above the ceiling limit. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits.

(g) Employers shall advise employees of all areas and operations where exposure to acrylonitrile could occur.

(8) **Common operations.** Common operations in which exposure to acrylonitrile is likely to occur include the following: Manufacture of the acrylonitrile monomer; synthesis of acrylic fibers, ABS, SAN, and nitrile barrier plastics and resins, nitrile rubber, surface coatings, specialty chemicals; use as a chemical intermediate; use as a fumigant; and in the cyanoethylation of cotton.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07338, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 88-11-021 (Order 88-04), § 296-62-07338, filed 5/11/88.]

WAC 296-62-07339 Appendix C--Medical surveillance guidelines for acrylonitrile.

(1) **Route of entry.**

(a) Inhalation;

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(b) Skin absorption;

(c) Ingestion.

(2) **Toxicology.**

(a) Acrylonitrile vapor is an asphyxiant due to inhibitory action on metabolic enzyme systems. Animals exposed to 75 or 100 ppm for seven hours have shown signs of anoxia; in some animals which died at the higher level, cyanomethemoglobin was found in the blood. Two human fatalities from accidental poisoning have been reported; one was caused by inhalation of an unknown concentration of the vapor, and the other was thought to be caused by skin absorption or inhalation. Most cases of intoxication from industrial exposure have been mild, with rapid onset of eye irritation, headache, sneezing, and nausea. Weakness, lightheadedness, and vomiting may also occur. Exposure to high concentrations may produce profound weakness, asphyxia, and death. The vapor is a severe eye irritant. Prolonged skin contract with the liquid may result in absorption with systemic effects, and in the formation of large blisters after a latent period of several hours. Although there is usually little or no pain or inflammation, the affected skin resembles a second-degree thermal burn. Solutions spilled on exposed skin, or on areas covered only by a light layer of clothing, evaporate rapidly, leaving no irritation, or, at the most, mild transient redness. Repeated spills on exposed skin may result in dermatitis due to solvent effects.

(b) Results after one year of a planned two-year animal study on the effects of exposure to acrylonitrile have indicated that rats ingesting as little as 35 ppm in their drinking water develop tumors of the central nervous system. The interim results of this study have been supported by a similar study being conducted by the same laboratory, involving exposure of rats by inhalation of acrylonitrile vapor, which has shown similar types of tumors in animals exposed to 80 ppm.

(c) In addition, the preliminary results of an epidemiological study being performed by duPont on a cohort of workers in their Camden, S.C. acrylic fiber plant indicate a statistically significant increase in the incidence of colon and lung cancers among employees exposed to acrylonitrile.

(3) **Signs and symptoms of acute overexposure.** Asphyxia and death can occur from exposure to high concentrations of acrylonitrile. Symptoms of overexposure include eye irritation, headache, sneezing, nausea and vomiting, weakness, and light-headedness. Prolonged skin contact can cause blisters on the skin with appearance of a second-degree burn, but with little or no pain. Repeated skin contact may produce scaling dermatitis.

(4) **Treatment of acute overexposure.** Remove employee from exposure. Immediately flush eyes with water and wash skin with soap or mild detergent and water. If AN has been swallowed, and person is conscious, induce vomiting. Give artificial respiration if indicated. More severe cases, such as those associated with loss of consciousness, may be treated by the intravenous administration of sodium nitrite, followed by sodium thiosulfate, although this is not as effective for acrylonitrile poisoning as for inorganic cyanide poisoning.

(5) **Surveillance and preventive considerations.**

(a) As noted above, exposure to acrylonitrile has been linked to increased incidence of cancers of the colon and lung in employees of the duPont acrylic fiber plant in Camden, S.C. In addition, the animal testing of acrylonitrile has resulted in the development of cancers of the central nervous system in rats exposed by either inhalation or ingestion. The physician should be aware of the findings of these studies in evaluating the health of employees exposed to acrylonitrile.

WAC 296-62-07339 (Cont.)

(b) Most reported acute effects of occupational exposure to acrylonitrile are due to its ability to cause tissue anoxia and asphyxia. The effects are similar to those caused by hydrogen cyanide. Liquid acrylonitrile can be absorbed through the skin upon prolonged contact. The liquid readily penetrates leather, and will produce burns of the feet if footwear contaminated with acrylonitrile is not removed.

(c) It is important for the physician to become familiar with the operating conditions in which exposure to acrylonitrile may occur. Those employees with skin diseases may not tolerate the wearing of whatever protective clothing may be necessary to protect them from exposure. In addition, those with chronic respiratory disease may not tolerate the wearing of negative-pressure respirators.

(d) Surveillance and screening. Medical histories and laboratory examinations are required for each employee subject to exposure to acrylonitrile above the action level. The employer must screen employees for history of certain medical conditions which might place the employee at increased risk from exposure.

(i) Central nervous system dysfunction. Acute effects of exposure to acrylonitrile generally involve the central nervous system. Symptoms of acrylonitrile exposure include headache, nausea, dizziness, and general weakness. The animal studies cited above suggest possible carcinogenic effects of acrylonitrile on the central nervous system, since rats exposed by either inhalation or ingestion have developed similar CNS tumors.

(ii) Respiratory disease. The duPont data indicate an increased risk of lung cancer among employees exposed to acrylonitrile.

(iii) Gastrointestinal disease. The duPont data indicate an increased risk of cancer of the colon among employees exposed to acrylonitrile. In addition, the animal studies show possible tumor production in the stomachs of the rats in the ingestion study.

(iv) Skin disease. Acrylonitrile can cause skin burns when prolonged skin contact with the liquid occurs. In addition, repeated skin contact with the liquid can cause dermatitis.

(e) General. The purpose of the medical procedures outlined in the standard is to establish a baseline for future health monitoring. Persons unusually susceptible to the effects of anoxia or those with anemia would be expected to be at increased risk. In addition to emphasis on the CNS, respiratory and gastro-intestinal systems, the cardiovascular system, liver, and kidney function should also be stressed.

[Statutory Authority: Chapter 49.17 RCW. 88-11-021 (Order 88-04), § 296-62-07339, filed 5/11/88.]

WAC 296-62-07340 Appendix D--Sampling and analytical methods for acrylonitrile.

(1) There are many methods available for monitoring employee exposures to acrylonitrile. Most of these involve the use of charcoal tubes and sampling pumps, with analysis by gas chromatograph. The essential differences between the charcoal tube methods include, among others, the use of different desorbing solvents, the use of different lots of charcoal, and the use of different equipment for analysis of the samples.

(2) Besides charcoal, considerable work has been performed on methods using porous polymer sampling tubes and passive dosimeters. In addition, there are several portable gas analyzers and monitoring units available on the open market.

(3) This appendix contains details for the methods which have been tested at OSHA Analytical Laboratory in Salt Lake City, and NIOSH in Cincinnati. Each is a variation on NIOSH Method S-156, which is also included for reference. This does not indicate that these methods are the only ones which will be

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satisfactory. There also may be workplace situations in which these methods are not adequate, due to such factors as high humidity. Copies of the other methods available to OSHA are available in the rulemaking record, and may be obtained from the OSHA docket office. These include, the Union Carbide, Monsanto, Dow Chemical and Dow Badische methods, as well as NIOSH Method P & CAM 127.

(4) Employers who note problems with sample breakthrough should try larger charcoal tubes. Tubes of larger capacity are available, and are often used for sampling vinyl chloride. In addition, lower flow rates and shorter sampling times should be beneficial in minimizing breakthrough problems.

(5) Whatever method the employer chooses, he must assure himself of the method's accuracy and precision under the unique conditions present in his workplace.

(6) NIOSH Method S-156 (unmodified)

Analyte: Acrylonitrile.

Matrix: Air.

Procedure: Absorption on charcoal, desorption with methanol, GC.

(a) Principle of the method. Reference (k)(i) of this subsection.

(i) A known volume of air is drawn through a charcoal tube to trap the organic vapors present.

(ii) The charcoal in the tube is transferred to a small, stoppered sample container, and the analyte is desorbed with methanol.

(iii) An aliquot of the desorbed sample is injected into a gas chromatograph.

(iv) The area of the resulting peak is determined and compared with areas obtained for standards.

(b) Range and sensitivity.

(i) This method was validated over the range of 17.5-70.0 mg/cu m at an atmospheric temperature and pressure of 22°C and 760 mm Hg, using a twenty-liter sample. Under the conditions of sample size (20 liters) the probable useful range of this method is 4.5-135 mg/cu m. The method is capable of measuring much smaller amounts if the desorption efficiency is adequate. Desorption efficiency must be determined over the range used.

(ii) The upper limit of the range of the method is dependent on the adsorptive capacity of the charcoal tube. This capacity varies with the concentrations of acrylonitrile and other substances in the air. The first section of the charcoal tube was found to hold at least 3.97 mg of acrylonitrile when a test atmosphere containing 92.0 mg/cu m of acrylonitrile in air was sampled 0.18 liter per minute for 240 minutes; at that time the concentration of acrylonitrile in the effluent was less than 5 percent of that in the influent. (The charcoal tube consists of two sections of activated charcoal separated by a section of urethane foam.) See (f)(ii) of this subsection. If a particular atmosphere is suspected of containing a large amount of contaminant, a smaller sampling volume should be taken.

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(c) Interference.

(i) When the amount of water in the air is so great that condensation actually occurs in the tube, organic vapors will not be trapped efficiently. Preliminary experiments using toluene indicate that high humidity severely decreases the breakthrough volume.

(ii) When interfering compounds are known or suspected to be present in the air, such information, including their suspected identities, should be transmitted with the sample.

(iii) It must be emphasized that any compound which has the same retention time as the analyte at the operating conditions described in this method is an interference. Retention time data on a single column cannot be considered proof of chemical identity.

(iv) If the possibility of interference exists, separation conditions (column packing, temperature, etc.) must be changed to circumvent the problem.

(d) Precision and accuracy.

(i) The coefficient of variation (CVt) for the total analytical and sampling method in the range of 17.5-70.0 mg/cu m was 0.073. This value corresponds to a 3.3 mg/cu m standard deviation at the (previous) OSHA standard level (20 ppm). Statistical information and details of the validation and experimental test procedures can be found in (k)(ii) of this subsection.

(ii) On the average the concentrations obtained at the 20 ppm level using the overall sampling and analytical method were 6.0 percent lower than the "true" concentrations for a limited number of laboratory experiments. Any difference between the "found" and "true" concentrations may not represent a bias in the sampling and analytical method, but rather a random variation from the experimentally determined "true" concentration. Therefore, no recovery correction should be applied to the final result in (j)(v) of this subsection.

(e) Advantages and disadvantages of the method.

(i) The sampling device is small, portable, and involves no liquids. Interferences are minimal, and most of those which do occur can be eliminated by altering chromatographic conditions. The tubes are analyzed by means of a quick, instrumental method.

(ii) The method can also be used for the simultaneous analysis of two or more substances suspected to be present in the same sample by simply changing gas chromatographic conditions.

(iii) One disadvantage of the method is that the amount of sample which can be taken is limited by the number of milligrams that the tube will hold before overloading. When the sample value obtained for the backup section of the charcoal tube exceeds 25 percent of that found on the front section, the possibility of sample loss exists.

(iv) Furthermore, the precision of the method is limited by the reproducibility of the pressure drop across the tubes. This drop will affect the flow rate and cause the volume to be imprecise, because the pump is usually calibrated for one tube only.

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(f) Apparatus.

(i) A calibrated personal sampling pump whose flow can be determined within ±5 percent at the recommended flow rate. Reference (k)(iii) of this subsection.

(ii) Charcoal tubes: Glass tubes with both ends flame sealed, 7 cm long with a 6 mm O.D. and a 4 mm I.D., containing 2 sections of 20/40 mesh activated charcoal separated by a 2 mm portion of urethane foam. The activated charcoal is prepared from coconut shells and is fired at 600°C prior to packing. The adsorbing section contains 100 mg of charcoal, the backup section 50 mg. A 3 mm portion of urethane foam is placed between the outlet end of the tube and the backup section. A plug of silicated glass wool is placed in front of the adsorbing section. The pressure drop across the tube must be less than 1 inch of mercury at a flow rate of 1 liter per minute.

(iii) Gas chromatograph equipped with a flame ionization detector.

(iv) Column (4 ft x 1/4 in stainless steel) packed with 50/80 mesh Poropak, type Q.

(v) An electronic integrator or some other suitable method for measuring peak areas.

(vi) Two-milliliter sample containers with glass stoppers or Teflon-lined caps. If an automatic sample injector is used, the associated vials may be used.

(vii) Microliter syringes: Ten-microliter and other convenient sizes for making standards.

(viii) Pipets: 1.0 ml delivery pipets.

(ix) Volumetric flask: 10 ml or convenient sizes for making standard solutions.

(g) Reagents.

(i) Chromatographic quality methanol.

(ii) Acrylonitrile, reagent grade.

(iii) Hexane, reagent grade.

(iv) Purified nitrogen.

(v) Prepurified hydrogen.

(vi) Filtered compressed air.

(h) Procedure.

(i) Cleaning of equipment. All glassware used for the laboratory analysis should be detergent washed and thoroughly rinsed with tap water and distilled water.

(ii) Calibration of personal pumps. Each personal pump must be calibrated with a representative charcoal tube in the line. This will minimize errors associated with uncertainties in the sample volume collected.

(iii) Collection and shipping of samples.

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(A) Immediately before sampling, break the ends of the tube to provide an opening at least one-half the internal diameter of the tube (2mm).

(B) The smaller section of charcoal is used as a backup and should be positioned nearest the sampling pump.

(C) The charcoal tube should be placed in a vertical direction during sampling to minimize channeling through the charcoal.

(D) Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.

(E) A maximum sample size of 20 liters is recommended. Sample at a flow of 0.20 liter per minute or less. The flow rate should be known with an accuracy of at least ±5 percent.

(F) The temperature and pressure of the atmosphere being sampled should be recorded. If pressure reading is not available, record the elevation.

(G) The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Under no circumstances should rubber caps be used.

(H) With each batch of ten samples submit one tube from the same lot of tubes which was used for sample collection and which is subjected to exactly the same handling as the samples except that no air is drawn through it. Label this as a blank.

(I) Capped tubes should be packed tightly and padded before they are shipped to minimize tube breakage during shipping.

(J) A sample of the bulk material should be submitted to the laboratory in a glass container with a Teflon-lined cap. This sample should not be transported in the same container as the charcoal tubes.

(iv) Analysis of samples.

(A) Preparation of samples. In preparation for analysis, each charcoal tube is scored with a file in front of the first section of charcoal and broken open. The glass wool is removed and discarded. The charcoal in the first (larger) section is transferred to a 2 ml stoppered sample container. The separating section of foam is removed and discarded; the second section is transferred to another stoppered container. These two sections are analyzed separately.

(B) Desorption of samples. Prior to analysis, 1.0 ml of methanol is pipetted into each sample container. Desorption should be done for 30 minutes. Tests indicate that this is adequate if the sample is agitated occasionally during this period. If an automatic sample injector is used, the sample vials should be capped as soon as the solvent is added to minimize volatilization.

(C) GC conditions. The typical operating conditions for the gas chromatograph are:

(I) 50 ml/min (60 psig) nitrogen carrier gas flow.

(II) 65 ml/min (24 psig) hydrogen gas flow to detector.

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(III) 500 ml/min (50 psig) air flow to detector.

(IV) 235°C injector temperature.

(V) 255°C manifold temperature (detector).

(VI) 155°C column temperature.

(D) Injection. The first step in the analysis is the injection of the sample into the gas chromatograph. To eliminate difficulties arising from blowback or distillation within the syringe needle, one should employ the solvent flush injection technique. The 10-microliter syringe is first flushed with solvent several times to wet the barrel and plunger. Three microliters of solvent are drawn into the syringe to increase the accuracy and reproducibility of the injected sample volume. The needle is removed from the solvent, and the plunger is pulled back about 0.2 microliter to separate the solvent flush from the sample with a pocket of air to be used as a marker. The needle is then immersed in the sample, and a five microliter aliquot is withdrawn, taking into consideration the volume of the needle, since the sample in the needle will be completely injected. After the needle is removed from the sample and prior to injection, the plunger is pulled back 1.2 microliters to minimize evaporation of the sample from the tip of the needle. Observe that the sample occupies 4.9-5.0 microliters in the barrel of the syringe. Duplicate injections of each sample and standard should be made. No more than a 3 percent difference in area is to be expected. An automatic sample injector can be used if it is shown to give reproducibility at least as good as the solvent flush method.

(E) Measurement of area. The area of the sample peak is measured by an electronic integrator or some other suitable form of area measurement, and preliminary results are read from a standard curve prepared as discussed below.

(v) Determination of desorption efficiency.

(A) Importance of determination. The desorption efficiency of a particular compound can vary from one laboratory to another and also from one batch of charcoal to another. Thus, it is necessary to determine at least once the percentage of the specific compound that is removed in the desorption process, provided the same batch of charcoal is used.

(B) Procedure for determining desorption efficiency.

(I) Activated charcoal equivalent to the amount in the first section of the sampling tube (100 mg) is measured into a 2.5 in., 4 mm I.D. glass tube, flame sealed at one end. This charcoal must be from the same batch as that used in obtaining the samples and can be obtained from unused charcoal tubes. The open end is capped with Parafilm. A known amount of hexane solution of acrylonitrile containing 0.239 g/ml is injected directly into the activated charcoal with a microliter syringe, and tube is capped with more Parafilm. When using an automatic sample injector, the sample injector vials, capped with Teflon-faced septa, may be used in place of the glass tube.

(II) The amount injected is equivalent to that present in a twenty-liter air sample at the selected level.

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(III) Six tubes at each of three levels (0.5X, 1X, and 2X of the standard) are prepared in this manner and allowed to stand for at least overnight to assure complete adsorption of the analyte onto the charcoal. These tubes are referred to as the sample. A parallel blank tube should be treated in the same manner except that no sample is added to it. The sample and blank tubes are desorbed and analyzed in exactly the same manner as the sampling tube described in (h)(iv) of this subsection.

(IV) Two or three standards are prepared by injecting the same volume of compound into 1.0 ml of methanol with the same syringe used in the preparation of the samples. These are analyzed with the samples.

(V) The desorption efficiency (D.E.) equals the average weight in mg recovered from the tube divided by the weight in mg added to the tube, or

$$D.E. = \frac{\text{Average weight recovered (mg)}}{\text{weight added (mg)}}$$

(VI) The desorption efficiency is dependent on the amount of analyte collected on the charcoal. Plot the desorption efficiency versus weight of analyte found. This curve is used in (j)(iv) of this subsection to correct for adsorption losses.

(i) Calibration and standards. It is convenient to express concentration of standards in terms of mg/1.0 ml methanol, because samples are desorbed in this amount of methanol. The density of the analyte is used to convert mg into microliters for easy measurement with a microliter syringe. A series of standards, varying in concentration over the range of interest, is prepared and analyzed under the same GC conditions and during the same time period as the unknown samples. Curves are established by plotting concentration in mg/1.0 ml versus peak area.

Note: Since no internal standard is used in the method, standard solutions must be analyzed at the same time that the sample analysis is done. This will minimize the effect of known day-to-day variations and variations during the same day of the FID response.

(j) Calculations.

(i) Read the weight, in mg, corresponding to each peak area from the standard curve. No volume corrections are needed, because the standard curve is based on mg/1.0 ml methanol and the volume of sample injected is identical to the volume of the standards injected.

(ii) Corrections for the bank must be made for each sample.

mg = mg sample-mg blank

Where:

mg sample = mg found in front section of sample tube.

mg sample = mg found in front section of blank tube.

Note: A similar procedure is followed for the backup sections.

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(iii) Add the weights found in the front and backup sections to get the total weight in the sample.

(iv) Read the desorption efficiency from the curve (reference (h)(v)(B) of this subsection) for the amount found in the front section. Divide the total weight by this desorption efficiency to obtain the corrected mg/sample.

$$\text{Corrected mg/sample} = \frac{\text{Total weight}}{\text{D.E.}}$$

(v) The concentration of the analyte in the air sampled can be expressed in mg/cu m.

$$\text{mg/cu m} = \text{Corrected mg (see (j)(iv))} \times \frac{1{,}000 \text{ (liter/cu m)}}{\text{air volume sampled (liter)}}$$

(vi) Another method of expressing concentration is ppm.

$$\text{ppm} = \text{mg/cu m} \times 24.45/\text{M.W.} \times 760/P \times T + 273/298$$

Where:

P = Pressure (mm Hg) of air sampled.

T = Temperature (°C) of air sampled.

24.45 = Molar volume (liter/mole) at 25°C and 760 mm Hg.

M.W. = Molecular weight (g/mole) of analyte.

760 = Standard pressure (mm Hg).

298 = Standard temperature (°K).

(k) References.

(i) White, L. D. et al., "A Convenient Optimized Method for the Analysis of Selected Solvent Vapors in the Industrial Atmosphere," Amer. Ind. Hyg. Assoc. J., 31:225 (1970).

(ii) Documentation of NIOSH Validation Tests, NIOSH Contract No. CDC-99-74-45.

(iii) Final Report, NIOSH Contract HSM-99-71-31, "Personal Sampler Pump for Charcoal Tubes," September 15, 1972.

(7) NIOSH Modification of NIOSH Method S-156. The NIOSH recommended method for low levels for acrylonitrile is a modification of method S-156. It differs in the following respects:

(a) Samples are desorbed using 1 ml of 1 percent acetone in CS2 rather than methanol.

(b) The analytical column and conditions are:

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(i) Column: 20 percent SP-1000 on 80/100 Supelcoport 10 feet x 1/8 inch S.S.

(ii) Conditions:

Injector temperature: 200°C.

Detector temperature: 100°C.

Column temperature: 85°C.

Helium flow: 25 ml/min.

Air flow: 450 ml/min.

Hydrogen flow: 55 ml/min.

(c) A 2 µl injection of the desorbed analyte is used.

(d) A sampling rate of 100 ml/min is recommended.

(8) OSHA Laboratory Modification of NIOSH Method S-156.

(a) Analyte: Acrylonitrile.

(b) Matrix: Air.

(c) Procedure: Adsorption on charcoal, desorption with methanol, GC.

(d) Principle of the method (subsection (1)(a) of this section).

(i) A known volume of air is drawn through a charcoal tube to trap the organic vapors present.

(ii) The charcoal in the tube is transferred to a small, stoppered sample vial, and the analyte is desorbed with methanol.

(iii) An aliquot of the desorbed sample is injected into a gas chromatograph.

(iv) The area of the resulting peak is determined and compared with areas obtained for standards.

(e) Advantages and disadvantages of the method.

(i) The sampling device is small, portable, and involves no liquids. Interferences are minimal, and most of those which do occur can be eliminated by altering chromatographic conditions. The tubes are analyzed by means of a quick, instrumental method.

(ii) This method may not be adequate for the simultaneous analysis of two or more substances.

(iii) The amount of sample which can be taken is limited by the number of milligrams that the tube will hold before overloading. When the sample value obtained for the backup section of the charcoal tube exceeds 25 percent of that found on the front section, the possibility of sample loss exists.

(iv) The precision of the method is limited by the reproducibility of the pressure drop across the tubes. This drop will affect the flow rate and cause the volume to be imprecise, because the pump is usually calibrated for one tube only.

(f) Apparatus.

(i) A calibrated personal sampling pump whose flow can be determined within ±5 percent at the recommended flow rate.

(ii) Charcoal tubes: Glass tube with both ends flame sealed, 7 cm long with a 6 mm O.D. and a 4 mm I.D., containing 2 sections of 20/40 mesh activated charcoal separated by a 2 mm portion of urethane foam. The activated charcoal is prepared from coconut shells and is fired at 600°C prior to packing. The absorbing section contains 100 mg of charcoal, the back-up section 50 mg. A 3 mm portion of urethane foam is placed between the outlet end of the tube and the back-up section. A plug of silicated glass wool is placed in front of the adsorbing section. The pressure drop across the tube must be less than one inch of mercury at a flow rate of 1 liter per minute.

(iii) Gas chromatograph equipped with a nitrogen phosphorus detector.

(iv) Column (10 ft x 1/8 in stainless steel) packed with 100/120 Supelcoport coated with 10 percent SP 1000.

(v) An electronic integrator or some other suitable method for measuring peak area.

(vi) Two-milliliter sample vials with Teflon-lined caps.

(vii) Microliter syringes: 10 microliter, and other convenient sizes for making standards.

(viii) Pipets: 1.0 ml delivery pipets.

(ix) Volumetric flasks: Convenient sizes for making standard solutions.

(g) Reagents.

(i) Chromatographic quality methanol.

(ii) Acrylonitrile, reagent grade.

(iii) Filtered compressed air.

(iv) Purified hydrogen.

(v) Purified helium.

(h) Procedure.

(i) Cleaning of equipment. All glassware used for the laboratory analysis should be properly cleaned and free of organics which could interfere in the analysis.

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(ii) Calibration of personal pumps. Each pump must be calibrated with a representative charcoal tube in the line.

(iii) Collection and shipping of samples.

(A) Immediately before sampling, break the ends of the tube to provide an opening at least one-half the internal diameter of the tube (2 mm).

(B) The smaller section of the charcoal is used as the backup and should be placed nearest the sampling pump.

(C) The charcoal should be placed in a vertical position during sampling to minimize channeling through the charcoal.

(D) Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.

(E) A sample size of 20 liters is recommended. Sample at a flow rate of approximately 0.2 liters per minute. The flow rate should be known with an accuracy of at least ±5 percent.

(F) The temperature and pressure of the atmosphere being sampled should be recorded.

(G) The charcoal tubes should be capped with the supplied plastic caps immediately after sampling. Rubber caps should not be used.

(H) Submit at least one blank tube (a charcoal tube subjected to the same handling procedures, without having any air drawn through it) with each set of samples.

(I) Take necessary shipping and packing precautions to minimize breakage of samples.

(iv) Analysis of samples.

(A) Preparation of samples. In preparation for analysis, each charcoal tube is scored with a file in front of the first section of charcoal and broken open. The glass wool is removed and discarded. The charcoal in the first (larger) section is transferred to a 2 ml vial. The separating section of foam is removed and discarded; the section is transferred to another capped vial. These two sections are analyzed separately.

(B) Desorption of samples. Prior to analysis, 1.0 ml of methanol is pipetted into each sample container. Desorption should be done for 30 minutes in an ultrasonic bath. The sample vials are recapped as soon as the solvent is added.

(C) GC conditions. The typical operating conditions for the gas chromatograph are:

(I) 30 ml/min (60 psig) helium carrier gas flow.

(II) 3.0 ml/min (30 psig) hydrogen gas flow to detector.

(III) 50 ml/min (60 psig) air flow to detector.

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(IV) 200°C injector temperature.

(V) 200°C dejector temperature.

(VI) 100°C column temperature.

(D) Injection. Solvent flush technique or equivalent.

(E) Measurement of area. The area of the sample peak is measured by an electronic integator or some other suitable form of area measurement, and preliminary results are read from a standard curve prepared as discussed below.

(v) Determination of desorption efficiency.

(A) Importance of determination. The desorption efficiency of a particular compound can vary from one laboratory to another and also from one batch of charcoal to another. Thus, it is necessary to determine, at least once, the percentage of the specific compound that is removed in the desorption process, provided the same batch of charcoal is used.

(B) Procedure for determining desorption efficiency. The reference portion of the charcoal tube is removed. To the remaining portion, amounts representing 0.5X, 1X, and 2X (X represents TLV) based on a 20 l air sample are injected onto several tubes at each level. Dilutions of acrylonitrile with methanol are made to allow injection of measurable quantities. These tubes are then allowed to equilibrate at least overnight. Following equilibration they are analyzed following the same procedure as the samples. A curve of the desorption efficiency (amt recovered/amt added) is plotted versus amount of analyte found. This curve is used to correct for adsorption losses.

(i) Calibration and standards. A series of standards, varying in concentration over the range of interest, is prepared and analyzed under the same GC conditions and during the same time period as the unknown samples. Curves are prepared by plotting concentration versus peak area.

Note: Since no internal standard is used in the method, standard solutions must be analyzed at the same time that the sample analysis is done. This will minimize the effect of known day-to-day variations and variations during the same day of the NPD response. Multiple injections are necessary.

(j) Calculations. Read the weight, corresponding to each peak area from the standard curve, correct for the blank, correct for the desorption efficiency, and make necessary air volume corrections.

(k) Reference. NIOSH Method S-156.

[Statutory Authority: Chapter 49.17 RCW. 88-11-021 (Order 88-04), § 296-62-07340, filed 5/11/88.]

WAC 296-62-07342 1,2-Dibromo-3-chloropropane.

(1) **Scope and application.**

(a) This section applies to occupational exposure to 1,2-dibromo-3-chloropropane (DBCP).

(b) This section does not apply to:

(i) Exposure to DBCP which results solely from the application and use of DBCP as a pesticide; or

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(ii) The storage, transportation, distribution or sale of DBCP in intact containers sealed in such a manner as to prevent exposure to DBCP vapors or liquids, except for the requirements of subsections (11), (16) and (17) of this section.

(2) **Definitions applicable to this section:**

(a) **"Authorized person"** - any person specifically authorized by the employer and whose duties require the person to be present in areas where DBCP is present; and any person entering this area as a designated representative of employees exercising an opportunity to observe employee exposure monitoring.

(b) **"DBCP"** - 1,2-dibromo-3-chloropropane, Chemical Abstracts Service Registry Number 96-12-8, and includes all forms of DBCP.

(c) **"Director"** - the director of labor and industries, or his authorized representative.

(d) **"Emergency"** - any occurrence such as, but not limited to equipment failure, rupture of containers, or failure of control equipment which may, or does, result in unexpected release of DBCP.

(3) **Permissible exposure limits.**

(a) Inhalation.

(i) Time-weighted average limit (TWA). The employer shall assure that no employee is exposed to an airborne concentration in excess of 1 part DBCP per billion part of air (ppb) as an eight-hour time-weighted average.

(ii) Ceiling limit. The employer shall assure that no employee is exposed to an airborne concentration in excess of 5 parts DBCP per billion parts of air (ppb) as averaged over any 15 minutes during the working day.

(b) Dermal and eye exposure. The employer shall assure that no employee is exposed to eye or skin contact with DBCP.

(4) **Notification of use.** Within ten days of the effective date of this section or within ten days following the introduction of DBCP into the workplace, every employer who has a workplace where DBCP is present shall report the following information to the director for each such workplace:

(a) The address and location of each workplace in which DBCP is present;

(b) A brief description of each process or operation which may result in employee exposure to DBCP;

(c) The number of employees engaged in each process or operation who may be exposed to DBCP and an estimate of the frequency and degree of exposure that occurs;

(d) A brief description of the employer's safety and health program as it relates to limitation of employee exposure to DBCP.

(5) **Regulated areas.** The employer shall establish, within each place of employment, regulated areas wherever DBCP concentrations are in excess of the permissible exposure limit.

(a) The employer shall limit access to regulated areas to authorized persons.

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(b) All employees entering or working in a regulated area shall wear respiratory protection in accordance with Table I.

(6) **Exposure monitoring.**

(a) General. Determinations of airborne exposure levels shall be made from air samples that are representative of each employee's exposure to DBCP over an eight-hour period. (For the purposes of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.)

(b) Initial. Each employer who has a place of employment in which DBCP is present shall monitor each workplace and work operation to accurately determine the airborne concentrations of DBCP to which employees may be exposed.

(c) Frequency.

(i) If the monitoring required by this section reveals employee exposures to be below the permissible exposure limits, the employer shall repeat these determinations at least quarterly.

(ii) If the monitoring required by this section reveals employee exposure to be in excess of the permissible exposure limits, the employer shall repeat these determinations for each such employee at least monthly. The employer shall continue these monthly determinations until at least two consecutive measurements, taken at least seven days apart, are below the permissible exposure limit, thereafter the employer shall monitor at least quarterly.

(d) Additional. Whenever there has been a production process, control or personnel change which may result in any new or additional exposure to DBCP, or whenever the employer has any other reason to suspect a change which may result in new or additional exposure to DBCP, additional monitoring which complies with subsection (6) shall be conducted.

(e) Employee notification.

(i) Within five working days after the receipt of monitoring results, the employer shall notify each employee in writing of results which represent the employee's exposure.

(ii) Whenever the results indicate that employee exposure exceeds the permissible exposure limit, the employer shall include in the written notice a statement that the permissible exposure limit was exceeded and a description of the corrective action being taken to reduce exposure to or below the permissible exposure limits.

(f) Accuracy of measurement. The method of measurement shall be accurate, to a confidence level of 95 percent, to within plus or minus 25 percent for concentrations of DBCP at or above the permissible exposure limits.

(7) **Methods of compliance.**

(a) Priority of compliance methods. The employer shall institute engineering and work-practice controls to reduce and maintain employee exposures to DBCP at or below the permissible

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exposure limit, except to the extent that the employer establishes that such controls are not feasible. Where feasible engineering and work-practice controls are not sufficient to reduce employee exposures to within the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest level achievable by these controls, and shall supplement them by use of respiratory protection.

(b) Compliance program.

(i) The employer shall establish and implement a written program to reduce employee exposure to DBCP to or below the permissible exposure limit solely by means of engineering and work-practice controls as required by this section.

(ii) The written program shall include a detailed schedule for development and implementation of the engineering and work-practice controls. These plans shall be revised at least every six months to reflect the current status of the program.

(iii) Written plans for these compliance programs shall be submitted upon request to the director, and shall be available at the worksite for examination and copying by the director, and any affected employee or designated representative of employees.

(iv) The employer shall institute and maintain at least the controls described in his most recent written compliance program.

(8) **Respiratory protection.**

(a) General. For employees who are required to use respirators under this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls;

(ii) Maintenance and repair activities for which engineering and work-practice controls are not feasible;

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limit;

(iv) Emergencies.

(b) The employer must establish, implement, and maintain a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(c) Respirator selection. The employer must select the appropriate respirator from Table I of this subsection.

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TABLE I
RESPIRATORY PROTECTION FOR DBCP

Concentration Not Greater Than		Respirator Type	
(a)	10 ppb:	(i)	Any supplied-air respirator.
		(ii)	Any self-contained breathing apparatus.
(b)	50 ppb:	(i)	Any supplied-air respirator with full facepiece, helmet, or hood.
		(ii)	Any self-contained breathing apparatus with full facepiece.
(c)	250 ppb:	(i)	A Type C supplied-air respirator operated in pressure-demand or other positive-pressure continuous flow mode.
(d)	500 ppb:	(i)	A Type C supplied-air respirator with full facepiece operated in pressure-demand mode with full facepiece.
(e)	Greater than 500 ppb or entry into unknown concentrations:	(i)	A combination respirator which includes a Type C supplied-air respirator with full facepiece operated in pressure-demand mode and an auxiliary self-contained breathing apparatus.
		(ii)	A self-contained breathing apparatus with full facepiece operated in pressure-demand mode.
(f)	Firefighting	(i)	A self-contained breathing apparatus with full facepiece operated in pressure-demand mode.

(9) **Reserved.**

(10) **Emergency situations.**

(a) Written plans.

(i) A written plan for emergency situations shall be developed for each workplace in which DBCP is present.

(ii) Appropriate portions of the plan shall be implemented in the event of an emergency.

(b) Employees engaged in correcting conditions shall be equipped as required in subsection (11) of this section until the emergency is abated.

(c) Evacuation. Employees not engaged in correcting the emergency shall be removed and restricted from the area and normal operations in the affected area shall not be resumed until the emergency is abated.

(d) Alerting employees. Where there is a possibility of employee exposure to DBCP due to the occurrence of an emergency, a general alarm shall be installed and maintained to promptly alert employees of such occurrences.

(e) Medical surveillance. For any employee exposed to DBCP in an emergency situation, the employer shall provide medical surveillance in accordance with subsection (14) of this section.

WAC 296-62-07342 (Cont.)

(f) Exposure monitoring.

(i) Following an emergency, the employer shall conduct monitoring which complies with subsection (6) of this section.

(ii) In workplaces not normally subject to periodic monitoring, the employer may terminate monitoring when two consecutive measurements indicate exposures below the permissible exposure limit.

(11) **Protective clothing and equipment.**

(a) Provision and use. Where eye or skin contact with liquid or solid DBCP may occur, employers shall provide at no cost to the employee, and assure that employees wear impermeable protective clothing and equipment in accordance with WAC 296-800-160 to protect the area of the body which may come in contact with DBCP.

(b) Cleaning and replacement.

(i) The employer shall clean, launder, maintain, or replace protective clothing and equipment required by this subsection to maintain their effectiveness. In addition, the employer shall provide clean protective clothing and equipment at least daily to each affected employee.

(ii) Removal and storage.

(A) The employer shall assure that employees remove DBCP contaminated work clothing only in change rooms provided in accordance with subsection (13) of this section.

(B) The employer shall assure that employees promptly remove any protective clothing and equipment which becomes contaminated with DBCP-containing liquids and solids. This clothing shall not be reworn until the DBCP has been removed from the clothing or equipment.

(C) The employer shall assure that no employee takes DBCP contaminated protective devices and work clothing out of the change room, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(iii) The employer shall assure that DBCP-contaminated protective work clothing and equipment is placed and stored in closed containers which prevent dispersion of DBCP outside the container.

(iv) The employer shall inform any person who launders or cleans DBCP-contaminated protective clothing or equipment of the potentially harmful effects of exposure to DBCP.

(v) The employer shall assure that the containers of contaminated protective clothing and equipment which are to be removed from the workplace for any reason are labeled in accordance with subsection (16)(c) of this section.

(vi) The employer shall prohibit the removal of DBCP from protective clothing and equipment by blowing or shaking.

WAC 296-62-07342 (Cont.)

(12) **Housekeeping.**

(a) Surfaces.

(i) All surfaces shall be maintained free of accumulations of DBCP.

(ii) Dry sweeping and the use of air for the cleaning of floors and other surfaces where DBCP dust or liquids are found is prohibited.

(iii) Where vacuuming methods are selected, either portable units or a permanent system may be used.

(A) If a portable unit is selected, the exhaust shall be attached to the general workplace exhaust ventilation system or collected within the vacuum unit, equipped with high efficiency filters or other appropriate means of contaminant removal, so that DBCP is not reintroduced into the workplace air; and

(B) Portable vacuum units used to collect DBCP may not be used for other cleaning purposes and shall be labeled as prescribed by subsection (16)(c) of this section.

(iv) Cleaning of floors and other contaminated surfaces may not be performed by washing down with a hose, unless a fine spray has first been laid down.

(b) Liquids. Where DBCP is present in a liquid form, or as a resultant vapor, all containers or vessels containing DBCP shall be enclosed to the maximum extent feasible and tightly covered when not in use.

(c) Waste disposal. DBCP waste, scrap, debris, bags, containers or equipment, shall be disposed in sealed bags or other closed containers which prevent dispersion of DBCP outside the container.

(13) **Hygiene facilities and practices.**

(a) Change rooms. The employer shall provide clean change rooms equipped with storage facilities for street clothes and separate storage facilities for protective clothing and equipment whenever employees are required to wear protective clothing and equipment in accordance with subsections (8), (9) and (11) of this section.

(b) Showers.

(i) The employer shall assure that employees working in the regulated area shower at the end of the work shift.

(ii) The employer shall assure that employees whose skin becomes contaminated with DBCP-containing liquids or solids immediately wash or shower to remove any DBCP from the skin.

(iii) The employer shall provide shower facilities in accordance with WAC 296-24-12009 (3)(c).

(c) Lunchrooms. The employer shall provide lunchroom facilities which have a temperature controlled, positive pressure, filtered air supply, and which are readily accessible to employees working in regulated areas.

WAC 296-62-07342 (Cont.)

(d) Lavatories.

(i) The employer shall assure that employees working in the regulated area remove protective clothing and wash their hands and face prior to eating.

(ii) The employer shall provide a sufficient number of lavatory facilities which comply with WAC 296-800-230.

(e) Prohibition of activities in regulated areas. The employer shall assure that, in regulated areas, food or beverages are not present or consumed, smoking products and implements are not present or used, and cosmetics are not present or applied.

(14) **Medical surveillance.**

(a) General. The employer shall institute a program of medical surveillance for each employee who is or will be exposed, without regard to the use of respirators, to DBCP. The employer shall provide each such employee with an opportunity for medical examinations and tests in accordance with this subsection. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee.

(b) Frequency and content. At the time of initial assignment, annually thereafter, and whenever exposure to DBCP occurs, the employer shall provide a medical examination for employees who work in regulated areas, which includes at least the following:

(i) A complete medical and occupational history with emphasis on reproductive history.

(ii) A complete physical examination with emphasis on the genito-urinary tract, testicle size, and body habitus including the following tests:

(A) Sperm count;

(B) Complete urinalysis (U/A);

(C) Complete blood count; and

(D) Thyroid profile.

(iii) A serum specimen shall be obtained and the following determinations made by radioimmunoassay techniques utilizing National Institutes of Health (NIH) specific antigen or one of equivalent sensitivity:

(A) Serum multiphasic analysis (SMA 12);

(B) Serum follicle stimulating hormone (FSH);

(C) Serum luteinizing hormone (LH); and

(D) Serum estrogen (females).

WAC 296-62-07342 (Cont.)

(iv) Any other tests deemed appropriate by the examining physician.

(c) Additional examinations. If the employee for any reason develops signs or symptoms commonly associated with exposure to DBCP, the employer shall provide the employee with a medical examination which shall include those elements considered appropriate by the examining physician.

(d) Information provided to the physician. The employer shall provide the following information to the examining physician:

(i) A copy of this standard and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The level of DBCP to which the employee is exposed; and

(iv) A description of any personal protective equipment used or to be used.

(e) Physician's written opinion.

(i) For each examination under this section, the employer shall obtain and provide the employee with a written opinion from the examining physician which shall include:

(A) The results of the medical tests performed;

(B) The physician's opinion as to whether the employee has any detected medical condition which would place the employee at an increased risk of material impairment of health from exposure to DBCP;

(C) Any recommended limitations upon the employee's exposure to DBCP or upon the use of protective clothing and equipment such as respirators; and

(D) A statement that the employee was informed by the physician of the results of the medical examination, and any medical conditions which require further examination or treatment.

(ii) The employer shall instruct the physician not to reveal in the written opinion specific findings or diagnoses unrelated to occupational exposure to DBCP.

(iii) The employer shall provide a copy of the written opinion to the affected employee.

(f) Emergency situations. If the employee is exposed to DBCP in an emergency situation, the employer shall provide the employee with a sperm count test as soon as practicable, or, if the employee is unable to produce a semen specimen, the hormone tests contained in subsection (14)(b) of this section. The employer shall provide these same tests three months later.

(15) **Employee information and training.**

(a) Training program.

(i) Within thirty days of the effective date of this standard, the employer shall institute a training program for all employees who may be exposed to DBCP and shall assure their participation in such training program.

WAC 296-62-07342 (Cont.)

(ii) The employer shall assure that each employee is informed of the following:

(A) The information contained in Appendices A, B and C;

(B) The quantity, location, manner of use, release or storage of DBCP and the specific nature of operations which could result in exposure to DBCP as well as any necessary protective steps;

(C) The purpose, proper use, limitations, and other training requirements covering respiratory protection as required in chapter 296-62 WAC, Part E;

(D) The purpose and description of the medical surveillance program required by subsection (14) of this section; and

(E) A review of this standard.

(b) Access to training materials.

(i) The employer shall make a copy of this standard and its appendices readily available to all affected employees.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to the director.

(16) **Signs and labels.**

(a) General.

(i) The employer may use labels or signs required by other statutes, regulations, or ordinances in addition to or in combination with, signs and labels required by this subsection.

(ii) The employer shall assure that no statement appears on or near any sign or label required by this subsection which contradicts or detracts from the required sign or label.

(b) Signs.

(i) The employer shall post signs to clearly indicate all work areas where DBCP may be present. These signs shall bear the legend:

DANGER
1,2-Dibromo-3-chloropropane

_____

(Insert appropriate trade or common names)

CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

(ii) Where airborne concentrations of DBCP exceed the permissible exposure limits, the signs shall bear the additional legend:

RESPIRATOR REQUIRED

WAC 296-62-07342 (Cont.)

(c) Labels.

(i) The employer shall assure that precautionary labels are affixed to all containers of DBCP and of products containing DBCP, and that the labels remain affixed when the DBCP or products containing DBCP are sold, distributed, or otherwise leave the employer's workplace. Where DBCP or products containing DBCP are sold, distributed or otherwise leave the employer's workplace bearing appropriate labels required by EPA under the regulations in 40 CFR Part 162, the labels required by this subsection need not be affixed.

(ii) The employer shall assure that the precautionary labels required by this subsection are readily visible and legible. The labels shall bear the following legend:

DANGER
1,2-Dibromo-3-chloropropane
CANCER HAZARD

(17) **Recordkeeping.**

(a) Exposure monitoring.

(i) The employer shall establish and maintain an accurate record of all monitoring required by subsection (6) of this section.

(ii) This record shall include:

(A) The dates, number, duration and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure;

(B) A description of the sampling and analytical methods used;

(C) Type of respiratory worn, if any; and

(D) Name, Social Security number, and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent.

(iii) The employer shall maintain this record for at least forty years or the duration of employment plus twenty years, whichever is longer.

(b) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance required by subsection (14) of this section.

(ii) This record shall include:

(A) The name and Social Security number of the employee;

(B) A copy of the physician's written opinion;

(C) Any employee medical complaints related to exposure to DBCP;

(D) A copy of the information provided the physician as required by subsection (14)(c) of this section; and

(E) A copy of the employee's medical and work history.

(iii) The employer shall maintain this record for at least forty years or the duration of employment plus twenty years, whichever is longer.

(c) Availability.

(i) The employer shall assure that all records required to be maintained by this section be made available upon request to the director for examination and copying.

(ii) Employee exposure monitoring records and employee medical records required by this subsection shall be provided upon request to employees' designated representatives and the assistant director in accordance with WAC 296-62-05201 through 296-62-05209; and 296-62-05213 through 296-62-05217.

(d) Transfer of records.

(i) If the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by this section for the prescribed period.

(ii) If the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall transmit these records by mail to the director.

(iii) At the expiration of the retention period for the records required to be maintained under this section, the employer shall transmit these records by mail to the director.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in WAC 296-62-05215.

(18) **Observation of monitoring.**

(a) Employee observation. The employer shall provide affected employees, or their designated representatives, an opportunity to observe any monitoring of employee exposure to DBCP conducted under subsection (6) of this section.

(b) Observation procedures.

(i) Whenever observation of the measuring or monitoring of employee exposure to DBCP requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the observer with personal protective clothing or equipment required to be worn by employees working in the area, assure the use of such clothing and equipment, and require the observer to comply with all other applicable safety and health procedures.

(ii) Without interfering with the monitoring or measurement, observers shall be entitled to:

WAC 296-62-07342 (Cont.)

(A) Receive an explanation of the measurement procedures;

(B) Observe all steps related to the measurement of airborne concentrations of DBCP performed at the place of exposure; and

(C) Record the results obtained.

(19) **Appendices.** The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07342, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10), § 296-62-07342, filed 05/04/99, effective 09/01/99. Statutory Authority: Chapter 49.17 RCW. 96-09-030 (Order 96-01), § 296-62-07342, filed 4/10/96, effective 6/1/96; 88-11-021 (Order 88-04), § 296-62-07342, filed 5/11/88.]

WAC 296-62-07343 Appendix A--Substance safety data sheet for DBCP.

(1) **Substance identification.**

(a) Synonyms and trades names: DBCP; Dibromochloropropane; Fumazone (Dow Chemical Company TM); Nemafume; Nemagon (Shell Chemical Co. TM); Nemaset; BBC 12; and OS 1879.

(b) Permissible exposure:

(i) Airborne. 1 part DBCP vapor per billion parts of air (1 ppb); time-weighted average (TWA) for an eight-hour workday.

(ii) Dermal. Eye contact and skin contact with DBCP are prohibited.

(c) Appearance and odor: Technical grade DBCP is a dense yellow or amber liquid with a pungent odor. It may also appear in granular form, or blended in varying concentrations with other liquids.

(d) Uses: DBCP is used to control nematodes, very small worm-like plant parasites, on crops including cotton, soybeans, fruits, nuts, vegetables and ornamentals.

(2) **Health hazard data.**

(a) Routes of entry: Employees may be exposed:

(i) Through inhalation (breathing);

(ii) Through ingestion (swallowing);

(iii) Skin contact; and

(iv) Eye contact.

(b) Effects of exposure:

(i) Acute exposure. DBCP may cause drowsiness, irritation of the eyes, nose, throat and skin, nausea and vomiting. In addition, overexposure may cause damage to the lungs, liver or kidneys.

WAC 296-62-07343 (Cont.)

(ii) Chronic exposure. Prolonged or repeated exposure to DBCP has been shown to cause sterility in humans. It also has been shown to produce cancer and sterility in laboratory animals and has been determined to constitute an increased risk of cancer in people.

(iii) Reporting signs and symptoms. If you develop any of the above signs or symptoms that you think are caused by exposure to DBCP, you should inform your employer.

(3) **Emergency first-aid procedures.**

(a) Eye exposure. If DBCP liquid or dust containing DBCP gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with DBCP.

(b) Skin exposure. If DBCP liquids or dusts containing DBCP get on your skin, immediately wash using soap or mild detergent and water. If DBCP liquids or dusts containing DBCP penetrate through your clothing, remove the clothing immediately and wash. If irritation is present after washing get medical attention.

(c) Breathing. If you or any person breathe in large amounts of DBCP, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Do not use mouth-to-mouth. Keep the affected person warm and at rest. Get medical attention as soon as possible.

(d) Swallowing. When DBCP has been swallowed and the person is conscious, give the person large amounts of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

(e) Rescue. Notify someone. Put into effect the established emergency rescue procedures. Know the locations of the emergency rescue equipment before the need arises.

(4) **Respirators and protective clothing.**

(a) Respirators. You may be required to wear a respirator in emergencies and while your employer is in the process of reducing DBCP exposures through engineering controls. If respirators are worn, they must have a label issued by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84 stating that the respirators have been certified for use with organic vapors. For effective protection, a respirator must fit your face and head snugly. The respirator should not be loosened or removed in work situations where its use is required. Respirators must not be loosened or removed in work situations where their use is required.

(b) Protective clothing. When working with DBCP you must wear for your protection impermeable work clothing provided by your employer. (Standard rubber and neoprene protective clothing do not offer adequate protection). DBCP must never be allowed to remain on the skin. Clothing and shoes must not be allowed to become contaminated with DBCP, and if they do, they must be promptly removed and not worn again until completely free of DBCP. Turn in impermeable clothing that has developed leaks for repair or replacement.

(c) Eye protection. You must wear splashproof safety goggles where there is any possibility of DBCP liquid or dust contacting your eyes.

WAC 296-62-07343 (Cont.)

(5) **Precautions for safe use, handling, and storage.**

(a) DBCP must be stored in tightly closed containers in a cool, well-ventilated area.

(b) If your work clothing may have become contaminated with DBCP, or liquids or dusts containing DBCP, you must change into uncontaminated clothing before leaving the work premises.

(c) You must promptly remove any protective clothing that becomes contaminated with DBCP. This clothing must not be reworn until the DBCP is removed from the clothing.

(d) If your skin becomes contaminated with DBCP, you must immediately and thoroughly wash or shower with soap or mild detergent and water to remove any DBCP from your skin.

(e) You must not keep food, beverages, cosmetics, or smoking materials, nor eat or smoke, in regulated areas.

(f) If you work in a regulated area, you must wash your hands thoroughly with soap or mild detergent and water, before eating, smoking or using toilet facilities.

(g) If you work in a regulated area, you must remove any protective equipment or clothing before leaving the regulated area.

(h) Ask your supervisor where DBCP is used in your work area and for any additional safety and health rules.

(6) **Access to information.**

(a) Each year, your employer is required to inform you of the information contained in this substance safety data sheet for DBCP. In addition, your employer must instruct you in the safe use of DBCP, emergency procedures, and the correct use of protective equipment.

(b) Your employer is required to determine whether you are being exposed to DBCP. You or your representative have the right to observe employee exposure measurements and to record the result obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being overexposed, they are required to inform you of the actions which are being taken to reduce your exposure.

(c) Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure and medical data for at least forty years or the duration of your employment plus twenty years, whichever is longer.

(d) Your employer is required to release exposure and medical records to you, your physician, or other individual designated by you upon your written request.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07343, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-62-07343, filed 7/20/94, effective 9/20/94; 88-11-021 (Order 88-04), § 296-62-07343, filed 5/11/88.]

WAC 296-62-07344 Appendix B--Substance technical guidelines for DBCP.

(1) **Physical and chemical data.**

(a) Substance identification.

WAC 296-62-07344 (Cont.)

(i) Synonyms: 1,2-dibromo-3-chloropropane; DBCP, Fumazone; Nemafume; Nemagon; Nemaset; BBC 12; OS 1879. DBCP is also included in agricultural pesticides and fumigants which include the phrase "Nema____, in their name.

(ii) Formula: $C_3H_5Br_2\ C_1$.

(iii) Molecular weight: 236.

(b) Physical data:

(i) Boiling point (760 mm HG): 195C (383F)

(ii) Specific gravity (water = 1): 2.093.

(iii) Vapor density (air = 1 at boiling point of DBCP): Data not available.

(iv) Melting point: 6C (43F).

(v) Vapor pressure at 20C (68F): 0.8 mm HG

(vi) Solubility in water: 1000 ppm.

(vii) Evaporation rate (Butyl Acetate = 1): Very much less than 1.

(c) Appearance and odor: Dense yellow or amber liquid with a pungent odor at high concentrations. Any detectable odor of DBCP indicates overexposure.

(2) **Fire explosion and reactivity hazard data.**

(a) Fire.

(i) Flash point: 170F (77C)

(ii) Autoignition temperature: Data not available.

(iii) Flammable limits in air, percent by volume: Data not available.

(iv) Extinguishing media: Carbon dioxide, dry chemical.

(v) Special fire-fighting procedures: Do not use a solid stream of water since a stream will scatter and spread the fire. Use water spray to cool containers exposed to a fire.

(vi) Unusual fire and explosion hazards: None known.

(vii) For purposes of complying with the requirements of WAC 296-24-330, liquid DBCP is classified as a Class III A combustible liquid.

(viii) For the purpose of complying with chapter 296-24 WAC Part L, the classification of hazardous locations as described in article 500 of the National Electrical Code for DBCP shall be Class I, Group D.

WAC 296-62-07344 (Cont.)

(ix) For the purpose of compliance with WAC 296-24-592, DBCP is classified as a Class B fire hazard.

(x) For the purpose of compliance with WAC 296-24-230, locations classified as hazardous locations due to the presence of DBCP shall be Class I, Group D.

(xi) Sources of ignition are prohibited where DBCP presents a fire or explosion hazard.

(b) Reactivity.

(i) Conditions contributing to instability: None known.

(ii) Incompatibilities: Reacts with chemically active metals, such as aluminum, magnesium and tin alloys.

(iii) Hazardous decomposition products: Toxic gases and vapors (such as HBr, HC1 and carbon monoxide) may be released in a fire involving DBCP.

(iv) Special precautions: DBCP will attack some rubber materials and coatings.

(3) **Spill, leak and disposal procedures.**

(a) If DBCP is spilled or leaked, the following steps should be taken:

(i) The area should be evacuated at once and re-entered only after thorough ventilation.

(ii) Ventilate area of spill or leak.

(iii) If in liquid form, collect for reclamation or absorb in paper, vermiculite, dry sand, earth or similar material.

(iv) If in solid form, collect spilled material in the most convenient and safe manner for reclamation or for disposal.

(b) Persons not wearing protective equipment must be restricted from areas of spills or leaks until cleanup has been completed.

(c) Waste disposal methods:

(i) For small quantities of liquid DBCP, absorb on paper towels, remove to a safe place (such as a fume hood) and burn the paper. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. If liquid DBCP is absorbed in vermiculite, dry sand, earth or similar material and placed in sealed containers it may be disposed of in a state-approved sanitary landfill.

(ii) If in solid form, for small quantities, place on paper towels, remove to a safe place (such as a fume hood) and burn. Large quantities may be reclaimed. However, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. DBCP in solid form may also be disposed in a state-approved sanitary landfill.

WAC 296-62-07344 (Cont.)

(4) **Monitoring and measurement procedures.**

(a) Exposure above the permissible exposure limit.

(i) Eight hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken so that the average eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

(ii) Monitoring techniques: The sampling and analysis under this section may be performed by collecting the DBCP vapor on petroleum based charcoal absorption tubes with subsequent chemical analyses. The method of measurement chosen should determine the concentration of airborne DBCP at the permissible exposure limit to an accuracy of plus or minus twenty-five percent. If charcoal tubes are used, a total volume of ten liters should be collected at a flow rate of 50 cc per minute for each tube. Analyze the resultant samples as you would samples of halogenated solvent.

(b) Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

(5) **Protective clothing.** Employees should be required to wear appropriate protective clothing to prevent any possibility of skin contact with DBCP. Because DBCP is absorbed through the skin, it is important to prevent skin contact with both liquid and solid forms of DBCP. Protective clothing should include impermeable coveralls or similar fullbody work clothing, gloves, headcoverings, and workshoes or shoe coverings. Standard rubber and neoprene gloves do not offer adequate protection and should not be relied upon to keep DBCP off the skin. DBCP should never be allowed to remain on the skin. Clothing and shoes should not be allowed to become contaminated with the material; and if they do, they should be promptly removed and not worn again until completely free of the material. Any protective clothing which has developed leaks or is otherwise found to be defective should be repaired or replaced. Employees should also be required to wear splashproof safety goggles where there is any possibility of DBCP contacting the eyes.

(6) **Housekeeping and hygiene facilities.**

(a) The workplace must be kept clean, orderly and in a sanitary condition.

(b) Dry sweeping and the use of compressed air is unsafe for the cleaning of floors and other surfaces where DBCP dust or liquids are found. To minimize the contamination of air with dust, vacuuming with either portable or permanent systems must be used. If a portable unit is selected, the exhaust must be attached to the general workplace exhaust ventilation system, or collected within the vacuum unit equipped with high efficiency filters or other appropriate means of contamination removal and not used for other purposes. Units used to collect DBCP must be labeled.

(c) Adequate washing facilities with hot and cold water must be provided, and maintained in a sanitary condition. Suitable cleansing agents should also be provided to assure the effective removal of DBCP from the skin.

(d) Change or dressing rooms with individual clothes storage facilities must be provided to prevent the contamination of street clothes with DBCP. Because of the hazardous nature of DBCP, contaminated protective clothing must be stored in closed containers for cleaning or disposal.

WAC 296-62-07344 (Cont.)

(7) **Miscellaneous precautions.**

(a) Store DBCP in tightly closed containers in a cool, well ventilated area.

(b) Use of supplied-air suits or other impervious clothing (such as acid suits) may be necessary to prevent skin contact with DBCP. Supplied-air suits should be selected, used, and maintained under the supervision of persons knowledgeable in the limitations and potential life-endangering characteristics of supplied-air suits.

(c) The use of air-conditioned suits may be necessary in warmer climates.

(d) Advise employees of all areas and operations where exposure to DBCP could occur.

(8) **Common operations.** Common operations in which exposure to DBCP is likely to occur are: During its production; and during its formulation into pesticides and fumigants.

[Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), § 296-62-07344, filed 11/22/91, effective 12/24/91; 88-11-021 (Order 88-04), § 296-62-07344, filed 5/11/88.]

WAC 296-62-07346 Appendix C--Medical surveillance guidelines for DBCP.

(1) **Route of entry.**

(a) Inhalation;

(b) Skin absorption.

(2) **Toxicology.** Recent data collected on workers involved in the manufacture and formulation of DBCP has shown that DBCP can cause sterility at very low levels of exposure. This finding is supported by studies showing that DBCP causes sterility in animals. Chronic exposure to DBCP resulted in pronounced necrotic action on the parenchymatous organs (i.e., liver, kidney, spleen) and on the testicles of rats at concentrations as low as 5 ppm. Rats that were chronically exposed to DBCP also showed changes in the composition of the blood, showing low RBC, hemoglobin, and WBC, and high reticulocyte levels as well as functional hepatic disturbance, manifesting itself in a long prothrombin time. Reznik et al., noted a single dose of 100 mg produced profound depression of the nervous system of rats. Their condition gradually improved. Acute exposure also resulted in the destruction of the sex gland activity of male rats as well as causing changes in the estrous cycle in female rats. Animal studies have also associated DBCP with an increased incidence of carcinoma. Olson, et al., orally administered DBCP to rats and mice five times per week at experimentally predetermined maximally tolerated doses and at half those doses. As early as ten weeks after initiation of treatment, DBCP induced a high incidence of squamous cell carcinomas of the stomach with metastases in both species. DBCP also induced mammary adenocarcinomas in the female rats at both dose levels.

(3) **Signs and symptoms.**

(a) Inhalation: Nausea, eye irritation, conjunctivitis, respiratory irritation, pulmonary congestion or edema, CNS depression with apathy, sluggishness, and ataxia.

(b) Dermal: Erythema or inflammation and dermatitis on repeated exposure.

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(4) **Special tests.**

(a) Semen analysis: The following information excerpted from the document "Evaluation of Testicular Function," submitted by the Corporate Medical Department of the Shell Oil Company (exhibit 39-3), may be useful to physicians conducting the medical surveillance program. In performing semen analyses certain minimal but specific criteria should be met:

(i) It is recommended that a minimum of three valid semen analyses be obtained in order to make a determination of an individual's average sperm count.

(ii) A period of sexual abstinence is necessary prior to the collection of each masturbatory sample. It is recommended that intercourse or masturbation be performed 48 hours before the actual specimen collection. A period of 48 hours of abstinence would follow; then the masturbatory sample would be collected.

(iii) Each semen specimen should be collected in a clean, widemouthed, glass jar (not necessarily pre-sterilized) in a manner designated by the examining physician. Any part of the seminal fluid exam should be initialed only after liquifaction is complete, i.e., 30 to 45 minutes after collection.

(iv) Semen volume should be measured to the nearest 1/10 of a cubic centimeter.

(v) Sperm density should be determined using routine techniques involving the use of a white cell pipette and a hemocytometer chamber. The immobilizing fluid most effective and most easily obtained for this process is distilled water.

(vi) Thin, dry smears of the semen should be made for a morphologic classification of the sperm forms and should be stained with either hematoxalin or the more difficult, yet more precise, Papanicolaou technique. Also of importance to record is obvious sperm agglutination, pyospermia, delayed liquifaction (greater than 30 minutes), and hyperviscosity. In addition, pH, using nitrazine paper, should be determined.

(vii) A total morphology evaluation should include percentages of the following:

(A) Normal (oval) forms,

(B) Tapered forms,

(C) Amorphous forms (include large and small sperm shapes),

(D) Duplicated (either heads or tails) forms, and

(E) Immature forms.

(viii) Each sample should be evaluated for sperm viability (percent viable sperm moving at the time of examination) as well as sperm motility (subjective characterization of "purposeful forward sperm progression" of the majority of those viable sperm analyzed) within two hours after collection, ideally by the same or equally qualified examiner.

(b) Serum determinations: The following serum determinations should be performed by radiommuno-assay techniques using National Institutes of Health (NIH) specific antigen or antigen preparations of equivalent sensitivity:

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(i) Serum follicle stimulating hormone (FSH),

(ii) Serum luteinizing hormone (LH), and

(iii) Serum total estrogen (females only).

(5) **Treatment.** Remove from exposure immediately, give oxygen or artificial resuscitation if indicated. Contaminated clothing and shoes should be removed immediately. Flush eyes and wash contaminated skin. If swallowed and the person is conscious, induce vomiting. Recovery from mild exposures is usually rapid and complete.

(6) **Surveillance and preventive considerations.**

(a) Other considerations. DBCP can cause both acute and chronic effects. It is important that the physician become familiar with the operating conditions in which exposure to DBCP occurs. Those with respiratory disorders may not tolerate the wearing of negative pressure respirators.

(b) Surveillance and screening. Medical histories and laboratory examinations are required for each employee subject to exposure to DBCP. The employer should screen employees for history of certain medical conditions (listed below) which might place the employee at increased risk from exposure:

(i) Liver disease. The primary site of biotransformation and detoxification of DBCP is the liver. Liver dysfunctions likely to inhibit the conjugation reactions will tend to promote the toxic actions of DBCP. These precautions should be considered before exposing persons with impaired liver function to DBCP.

(ii) Renal disease. Because DBCP has been associated with injury to the kidney it is important that special consideration be given to those with possible impairment of renal function.

(iii) Skin disease. DBCP can penetrate the skin and can cause erythema on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of DBCP.

(iv) Blood dyscrasias. DBCP has been shown to decrease the content of erythrocytes, hemoglobin, and leukocytes in the blood, as well as increase the prothrombin time. Persons with existing blood disorders may be more susceptible to the effects of DBCP.

(v) Reproductive disorders. Animal studies have associated DBCP with various effects on the reproductive organs. Among these effects are atrophy of the testicles and changes in the estrous cycle. Persons with pre-existing reproductive disorders may be at increased risk to these effects of DBCP.

(7) **References.**

(a) Reznik, Ya. B. and Sprinchan, G. K.: Experimental Data on the Gonadotoxic effect of Nemagon, Gig. Sanit., (6), 1975, pp. 101-102, (translated from Russian).

(b) Faydysh, E. V., Rakhmatullaev, N. N. and Varshavskii, V. A.: The Cytotoxic Action of Nemagon in a Subacute Experiment, Med. Zh. Uzbekistana, (No. 1), 1970, pp. 64-65, (translated from Russian).

(c) Rakhmatullaev, N. N.: Hygienic Characteristics of the Nematocide Nemagon in Relation to Water Pollution Control, Hyg. Sanit., 36(3), 1971, pp. 344-348, (translated from Russian).

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(d) Olson, W. A. et al.: Induction of Stomach Cancer in Rats and Mice by Halogenated Aliphatic Fumigants, Journal of the National Cancer Institute, (51), 1973, pp. 1993-1995.

(e) Torkelson, T. R. et al.: Toxicologic Investigations of 1,2-Dibromo-3-chloropropane, Toxicology and Applied Pharmacology, 3, 1961 pp. 545-559.

[Statutory Authority: Chapter 49.17 RCW. 88-11-021 (Order 88-04), § 296-62-07346, filed 5/11/88.]

WAC 296-62-07347 Inorganic arsenic.

(1) **Scope and application.** This section applies to all occupational exposures to inorganic arsenic except that this section does not apply to employee exposures in agriculture or resulting from pesticide application, the treatment of wood with preservatives or the utilization of arsenically preserved wood.

(2) **Definitions.**

(a) **"Action level"** - a concentration of inorganic arsenic of 5 micrograms per cubic meter of air (5 $\mu g/m^3$) averaged over any eight-hour period.

(b) **"Authorized person"** - any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees for the purpose of exercising the right to observe monitoring and measuring procedures under subsection (5) of this section.

(c) **"Director"** - the director of the department of labor and industries, or his/her designated representative.

(d) **"Inorganic arsenic"** - copper aceto-arsenite and all inorganic compounds containing arsenic except arsine, measured as arsenic (As).

(3) **Permissible exposure limit.** The employer shall assure that no employee is exposed to inorganic arsenic at concentrations greater than 10 micrograms per cubic meter of air (10 $\mu g/m^3$), averaged over any eight-hour period.

(4) **Notification of use.**

(a) Within sixty days after the introduction of inorganic arsenic into the workplace, every employer who is required to establish a regulated area in his/her workplaces shall report in writing to the department of labor and industries for each such workplace:

(i) The address of each such workplace;

(ii) The approximate number of employees who will be working in regulated areas; and

(iii) A brief summary of the operations creating the exposure and the actions which the employer intends to take to reduce exposures.

(b) Whenever there has been a significant change in the information required by subsection (4)(a) of this section, the employer shall report the changes in writing within sixty days to the department of labor and industries.

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(5) **Exposure monitoring.**

(a) General.

(i) Determinations of airborne exposure levels shall be made from air samples that are representative of each employee's exposure to inorganic arsenic over an eight-hour period.

(ii) For the purposes of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.

(iii) The employer shall collect full shift (for at least seven continuous hours) personal samples including at least one sample for each shift for each job classification in each work area.

(b) Initial monitoring. Each employer who has a workplace or work operation covered by this standard shall monitor each such workplace and work operation to accurately determine the airborne concentration of inorganic arsenic to which employees may be exposed.

(c) Frequency.

(i) If the initial monitoring reveals employee exposure to be below the action level the measurements need not be repeated except as otherwise provided in subsection (5)(d) of this section.

(ii) If the initial monitoring, required by this section, or subsequent monitoring reveals employee exposure to be above the permissible exposure limit, the employer shall repeat monitoring at least quarterly.

(iii) If the initial monitoring, required by this section, or subsequent monitoring reveals employee exposure to be above the action level and below the permissible exposure limit the employee shall repeat monitoring at least every six months.

(iv) The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least seven days apart, are below the action level at which time the employer may discontinue monitoring for that employee until such time as any of the events in subsection (5)(d) of this section occur.

(d) Additional monitoring. Whenever there has been a production, process, control or personal change which may result in new or additional exposure to inorganic arsenic, or whenever the employer has any other reason to suspect a change which may result in new or additional exposures to inorganic arsenic, additional monitoring which complies with subsection (5) of this section shall be conducted.

(e) Employee notification.

(i) Within five working days after the receipt of monitoring results, the employer shall notify each employee in writing of the results which represent that employee's exposures.

(ii) Whenever the results indicate that the representative employee exposure exceeds the permissible exposure limit, the employer shall include in the written notice a statement that the permissible exposure limit was exceeded and a description of the corrective action taken to reduce exposure to or below the permissible exposure limit.

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(f) Accuracy of measurement.

(i) The employer shall use a method of monitoring and measurement which has an accuracy (with a confidence level of 95 percent) of not less than plus or minus 25 percent for concentrations of inorganic arsenic greater than or equal to 10 $\mu g/m^3$.

(ii) The employer shall use a method of monitoring and measurement which has an accuracy (with confidence level of 95 percent) of not less than plus or minus 35 percent for concentrations of inorganic arsenic greater than 5 $\mu g/m^3$ but less than 10 $\mu g/m^3$.

(6) **Regulated area.**

(a) Establishment. The employer shall establish regulated areas where worker exposures to inorganic arsenic, without regard to the use of respirators, are in excess of the permissible limit.

(b) Demarcation. Regulated areas shall be demarcated and segregated from the rest of the workplace in any manner that minimizes the number of persons who will be exposed to inorganic arsenic.

(c) Access. Access to regulated areas shall be limited to authorized persons or to persons otherwise authorized by the Act or regulations issued pursuant thereto to enter such areas.

(d) Provision of respirators. All persons entering a regulated area shall be supplied with a respirator, selected in accordance with subsection (8)(c) of this section.

(e) Prohibited activities. The employer shall assure that in regulated areas, food or beverages are not consumed, smoking products, chewing tobacco and gum are not used and cosmetics are not applied, except that these activities may be conducted in the lunchrooms, change rooms and showers required under subsection (12) of this section. Drinking water may be consumed in the regulated area.

(7) **Methods of compliance.**

(a) Controls.

(i) The employer shall institute engineering and work-practice controls to reduce exposures to or below the permissible exposure limit, except to the extent that the employer can establish that such controls are not feasible.

(ii) Where engineering and work-practice controls are not sufficient to reduce exposures to or below the permissible exposure limit, they shall nonetheless be used to reduce exposures to the lowest levels achievable by these controls and shall be supplemented by the use of respirators in accordance with subsection (8) of this section and other necessary personal protective equipment. Employee rotation is not required as a control strategy before respiratory protection is instituted.

(b) Compliance program.

(i) The employer shall establish and implement a written program to reduce exposures to or below the permissible exposure limit by means of engineering and work-practice controls.

(ii) Written plans for these compliance programs shall include at least the following:

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(A) A description of each operation in which inorganic arsenic is emitted; e.g., machinery used, material processed, controls in place, crew size, operating procedures and maintenance practices;

(B) Engineering plans and studies used to determine methods selected for controlling exposure to inorganic arsenic;

(C) A report of the technology considered in meeting the permissible exposure limit;

(D) Monitoring data;

(E) A detailed schedule for implementation of the engineering controls and work-practices that cannot be implemented immediately and for the adaption and implementation of any additional engineering and work-practices necessary to meet the permissible exposure limit;

(F) Whenever the employer will not achieve the permissible exposure limit with engineering controls and work-practices, the employer shall include in the compliance plan an analysis of the effectiveness of the various controls, shall install engineering controls and institute work-practices on the quickest schedule feasible, and shall include in the compliance plan and implement a program to minimize the discomfort and maximize the effectiveness of respirator use; and

(G) Other relevant information.

(iii) Written plans for such a program shall be submitted upon request to the director, and shall be available at the worksite for examination and copying by the director, any affected employee or authorized employee representatives.

(iv) The plans required by this subsection shall be revised and updated at least every six months to reflect the current status of the program.

(8) **Respiratory protection.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering or work-practice controls;

(ii) Work operations, such as maintenance and repair activities, in which the employer establishes that engineering and work-practice controls are not feasible;

(iii) Work operations for which engineering work-practice controls are not yet sufficient to reduce employee exposures to or below the permissible exposure limit;

(iv) Emergencies.

(b) Respirator program.

(i) The employer must establish, implement, and maintain a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

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(ii) If an employee exhibits breathing difficulty during fit testing or respirator use, they must be examined by a physician trained in pulmonary medicine to determine whether they can use a respirator while performing the required duty.

(c) Respirator selection.

(i) The employer must use Table I of this section to select the appropriate respirator or combination of respirators for inorganic arsenic compounds without significant vapor pressure, and Table II of this section to select the appropriate respirator or combination of respirators for inorganic arsenic compounds that have significant vapor pressure.

(ii) Where employee exposures exceed the permissible exposure limit for inorganic arsenic and also exceed the relevant limit for other gases (for example, sulfur dioxide), any air-purifying respirator provided to the employee as specified by this section must have a combination high-efficiency filter with an appropriate gas sorbent. (See footnote in Table I)

(iii) Employees required to use respirators may choose, and the employer must provide, a powered air-purifying respirator if it will provide proper protection. In addition, the employer must provide a combination dust and acid-gas respirator to employees who are exposed to gases over the relevant exposure limits.

TABLE I
RESPIRATORY PROTECTION FOR INORGANIC ARSENIC PARTICULATE EXCEPT FOR THOSE WITH SIGNIFICANT VAPOR PRESSURE

Concentration of Inorganic Arsenic (as As) or Condition of Use		Respirator Required	
(i)	Unknown or greater or lesser than 20,000 $\mu g/m^3$ (20 mg/m^3) firefighting.	(A)	Any full facepiece self-contained breathing apparatus operated in positive-pressure mode.
(ii)	Not greater than 20,000 $\mu g/m^3$ (20 mg/m^3)	(A)	Supplied-air respirator with full facepiece, hood, or helmet or suit and operated in positive-pressure mode.
(iii)	Not greater than 10,000 $\mu g/m^3$ (10 mg/m^3)	(A) (B)	Powered air-purifying respirators in all inlet face coverings with high-efficiency filters.[1] Half-mask supplied air respirators operated in positive-pressure mode.
(iv)	Not greater than 500 $\mu g/m^3$	(A) (B) (C)	Full facepiece air-purifying respirator equipped with high-efficiency filter.[1] Any full facepiece supplied-air respirator. Any full facepiece self-contained breathing apparatus.
(v)	Not greater than 100 $\mu g/m^3$	(A) (B)	Half-mask air-purifying respirator equipped with high-efficiency filter.[1] Any half-mask supplied-air respirator.

[1]High-efficiency filter-99.97 pct efficiency against 0.3 micrometer monodisperse diethyl-hexyl phthalate (DOP) particles.

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TABLE II
RESPIRATORY PROTECTION FOR INORGANIC ARSENICALS (SUCH AS ARSENIC TRICHLORIDE[2] AND ARSENIC PHOSPHIDE) WITH SIGNIFICANT VAPOR PRESSURE

Concentration of Inorganic Arsenic (as As) or Condition of Use		Respirator Required	
(i)	Unknown or greater or lesser than 20,000 μg/m^3(20 mg/m^3) or firefighting.	(A)	Any full facepiece contained breathing apparatus operated in positive-pressure mode.
(ii)	Not greater than 20,000 μg/m^3(20 mg/m^3)	(A)	Any full facepiece contained breathing apparatus operated in positive-pressure mode.
		(B)	Supplied-air respirator with full facepiece hood, or helmet or suit and operated in positive-pressure mode.
(iii)	Not greater than 10,000 μg/m^3(10 mg/m^3)	(A)	Half-mask[2] supplied air respirator operated in positive-pressure mode.
(iv)	Not greater than 500 μg/m^3	(A)	Front or back mounted gas mask equipped with high-efficiency filter[1] and acid gas canister.
		(B)	Any full facepiece supplied-air respirator.
		(C)	Any full facepiece self-contained breathing apparatus.
(v)	Not greater than 100 μg/m^3	(A)	half-mask[2] air-purifying respirator equipped with high-efficiency filter[1] and acid gas cartridge.
		(B)	Any half-mask supplied-air respirator.

[1]High efficiency filter-99.97 pct efficiency against 0.3 micrometer monodisperse diethyl-hexyl phthalate (DOP) particles.

[2]Half-mask respirators shall not be used for protection against arsenic trichloride, as it is rapidly absorbed through the skin.

(9) **Reserved.**

(10) **Protective work clothing and equipment.**

(a) Provision and use. Where the possibility of skin or eye irritation from inorganic arsenic exists, and for all workers working in regulated areas, the employer shall provide at no cost to the employee and assure that employees use appropriate and clean protective work clothing and equipment such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, and shoes or coverlets;

(iii) Face shields or vented goggles when necessary to prevent eye irritation, which comply with the requirements of WAC 296-800-160.

(iv) Impervious clothing for employees subject to exposure to arsenic trichloride.

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(b) Cleaning and replacement.

(i) The employer shall provide the protective clothing required in subsection (10)(a) of this section in a freshly laundered and dry condition at least weekly, and daily if the employee works in areas where exposures are over 100 $\mu g/m^3$ of inorganic arsenic or in areas where more frequent washing is needed to prevent skin irritation.

(ii) The employer shall clean, launder, or dispose of protective clothing required by subsection (10)(a) of this section.

(iii) The employer shall repair or replace the protective clothing and equipment as needed to maintain their effectiveness.

(iv) The employer shall assure that all protective clothing is removed at the completion of a work shift only in change rooms prescribed in subsection (13)(a) of this section.

(v) The employer shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change-room which prevents dispersion of inorganic arsenic outside the container.

(vi) The employer shall inform in writing any person who cleans or launders clothing required by this section, of the potentially harmful affects including the carcinogenic effects of exposure to inorganic arsenic.

(vii) The employer shall assure that the containers of contaminated protective clothing and equipment in the workplace or which are to be removed from the workplace are labeled as follows:

Caution: *Clothing contaminated with inorganic arsenic; do not remove dust by blowing or shaking. Dispose of inorganic arsenic contaminated wash water in accordance with applicable local, state, or federal regulations.*

(viii) The employer shall prohibit the removal of inorganic arsenic from protective clothing or equipment by blowing or shaking.

(11) **Housekeeping.**

(a) Surfaces. All surfaces shall be maintained as free as practicable of accumulations of inorganic arsenic.

(b) Cleaning floors. Floors and other accessible surfaces contaminated with inorganic arsenic may not be cleaned by the use of compressed air, and shoveling and brushing may be used only where vacuuming or other relevant methods have been tried and found not to be effective.

(c) Vacuuming. Where vacuuming methods are selected, the vacuums shall be used and emptied in a manner to minimize the reentry of inorganic arsenic into the workplace.

(d) Housekeeping plan. A written housekeeping and maintenance plan shall be kept which shall list appropriate frequencies for carrying out housekeeping operations, and for cleaning and maintaining dust collection equipment. The plan shall be available for inspection by the director.

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(e) Maintenance of equipment. Periodic cleaning of dust collection and ventilation equipment and checks of their effectiveness shall be carried out to maintain the effectiveness of the system and a notation kept of the last check of effectiveness and cleaning or maintenance.

(12) **Reserved**.

(13) **Hygiene facilities and practices.**

(a) Change rooms. The employer shall provide for employees working in regulated areas or subject to the possibility of skin or eye irritation from inorganic arsenic, clean change rooms equipped with storage facilities for street clothes and separate storage facilities for protective clothing and equipment in accordance with WAC 296-24-12011.

(b) Showers.

(i) The employer shall assure that employees working in regulated areas or subject to the possibility of skin or eye irritation from inorganic arsenic shower at the end of the work shift.

(ii) The employer shall provide shower facilities in accordance with WAC 296-24-12009(3).

(c) Lunchrooms.

(i) The employer shall provide for employees working in regulated areas, lunchroom facilities which have a temperature controlled, positive pressure, filtered air supply, and which are readily accessible to employees working in regulated areas.

(ii) The employer shall assure that employees working in the regulated area or subject to the possibility of skin or eye irritation from exposure to inorganic arsenic wash their hands and face prior to eating.

(d) Lavatories. The employer shall provide lavatory facilities which comply with WAC 296-800-230.

(e) Vacuuming clothes. The employer shall provide facilities for employees working in areas where exposure, without regard to the use of respirators, exceeds 100 $\mu g/m^3$ to vacuum their protective clothing and clean or change shoes worn in such areas before entering change rooms, lunchrooms or shower rooms required by subsection (10) of this section and shall assure that such employees use such facilities.

(f) Avoidance of skin irritation. The employer shall assure that no employee is exposed to skin or eye contact with arsenic trichloride, or to skin or eye contact with liquid or particulate inorganic arsenic which is likely to cause skin or eye irritation.

(14) **Medical surveillance.**

(a) General.

(i) Employees covered. The employer shall institute a medical surveillance program for the following employees:

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(A) All employees who are or will be exposed above the action level, without regard to the use of respirators, at least thirty days per year; and

(B) All employees who have been exposed above the action level, without regard to respirator use, for thirty days or more per year for a total of ten years or more of combined employment with the employer or predecessor employers prior to or after the effective date of this standard. The determination of exposures prior to the effective date of this standard shall be based upon prior exposure records, comparison with the first measurements taken after the effective date of this standard, or comparison with records of exposures in areas with similar processes, extent of engineering controls utilized and materials used by that employer.

(ii) Examination by physician. The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(b) Initial examinations. For employees initially covered by the medical provisions of this section, or thereafter at the time of initial assignment to an area where the employee is likely to be exposed over the action level at least thirty days per year, the employer shall provide each affected employee an opportunity for a medical examination, including at least the following elements:

(i) A work history and a medical history which shall include a smoking history and the presence and degree of respiratory symptoms such as breathlessness, cough, sputum production and wheezing.

(ii) A medical examination which shall include at least the following:

(A) A 14" by 17" posterior-anterior chest x-ray and International Labor Office UICC/Cincinnati (ILO U/C) rating;

(B) A nasal and skin examination; and

(C) Other examinations which the physician believes appropriate because of the employees exposure to inorganic arsenic or because of required respirator use.

(c) Periodic examinations.

(i) The employer shall provide the examinations specified in subsection (14)(b)(i) and (ii)(A), (B) and (C) of this section at least annually for covered employees who are under forty-five years of age with fewer than ten years of exposure over the action level without regard to respirator use.

(ii) The employer shall provide the examinations specified in subsection (14)(b)(i) and (ii)(B) and (C) of this section at least semi-annually, and the x-ray requirements specified in subsection (14(b)(ii)(A) of this section at least annually, for other covered employees.

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(iii) Whenever a covered employee has not taken the examinations specified in subsection (14)(b)(i) and (ii)(B) and (C) of this section within six months preceding the termination of employment, the employer shall provide such examinations to the employee upon termination of employment.

(d) Additional examinations. If the employee for any reason develops signs or symptoms commonly associated with exposure to inorganic arsenic the employer shall provide an appropriate examination and emergency medical treatment.

(e) Information provided to the physician. The employer shall provide the following information to the examining physician:

(i) A copy of this standard and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's representative exposure level or anticipated exposure level;

(iv) A description of any personal protective equipment used or to be used; and

(v) Information from previous medical examinations of the affected employee which is not readily available to the examining physician.

(f) Physician's written opinion.

(i) The employer shall obtain a written opinion from the examining physician which shall include:

(A) The results of the medical examination and tests performed;

(B) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from exposure to inorganic arsenic;

(C) Any recommended limitations upon the employee's exposure to inorganic arsenic or upon the use of protective clothing or equipment such as respirators; and

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The employer shall instruct the physician not to reveal in the written opinion specific findings or diagnoses unrelated to occupational exposure.

(iii) The employer shall provide a copy of the written opinion to the affected employee.

(15) **Employee information and training.**

(a) Training program.

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(i) The employer shall institute a training program for all employees who are subject to exposure to inorganic arsenic above the action level without regard to respirator use, or for whom there is the possibility of skin or eye irritation from inorganic arsenic. The employer shall assure that those employees participate in the training program.

(ii) The training program shall be provided by October 1, 1978 for employees covered by this provision, at the time of initial assignment for those subsequently covered by this provision, and shall be repeated at least quarterly for employees who have optional use of respirators and at least annually for other covered employees thereafter, and the employer shall assure that each employee is informed of the following:

(A) The information contained in Appendix A;

(B) The quantity, location, manner of use, storage, sources of exposure, and the specific nature of operations which could result in exposure to inorganic arsenic as well as any necessary protective steps;

(C) The purpose, proper use, and limitation of respirators;

(D) The purpose and a description of medical surveillance program as required by subsection (14) of this section;

(E) The engineering controls and work-practices associated with the employee's job assignment; and

(F) A review of this standard.

(b) Access to training materials.

(i) The employer shall make readily available to all affected employees a copy of this standard and its appendices.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to the director.

(16) **Signs and labels.**

(a) General.

(i) The employer may use labels or signs required by other statutes, regulations, or ordinances in addition to, or in combination with, signs and labels required by this subsection.

(ii) The employer shall assure that no statement appears on or near any sign or label required by this subsection which contradicts or detracts from the meaning of the required sign or label.

(b) Signs.

(i) The employer shall post signs demarcating regulated areas bearing the legend:

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DANGER
INORGANIC ARSENIC
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY
NO SMOKING OR EATING
RESPIRATOR REQUIRED

(ii) The employer shall assure that signs required by this subsection are illuminated and cleaned as necessary so that the legend is readily visible.

(c) Labels. The employer shall apply precautionary labels to all shipping and storage containers of inorganic arsenic, and to all products containing inorganic arsenic except when the inorganic arsenic in the product is bound in such a manner so as to make unlikely the possibility of airborne exposure to inorganic arsenic. (Possible examples of products not requiring labels are semiconductors, light emitting diodes and glass.) The label shall bear the following legend:

DANGER
CONTAINS INORGANIC ARSENIC
CANCER HAZARD
HARMFUL IN INHALED OR SWALLOWED
USE ONLY WITH ADEQUATE
VENTILATION
OR RESPIRATORY PROTECTION

(17) **Recordkeeping.**

(a) Exposure monitoring.

(i) The employer shall establish and maintain an accurate record of all monitoring required by subsection (5) of this section.

(ii) This record shall include:

(A) The date(s), number, duration location, and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure where applicable;

(B) A description of the sampling and analytical methods used and evidence of their accuracy;

(C) The purpose, proper use, limitations, and other training requirements covering respiratory protection as required in chapter 296-62 WAC, Part E;

(D) Name, Social Security number, and job classification of the employees monitored and of all other employees whose exposure the measurement is intended to represent; and

(E) The environmental variables that could affect the measurement of the employee's exposure.

(iii) The employer shall maintain these monitoring records for at least forty years or for the duration of employment plus twenty years, whichever is longer.

WAC 296-62-07347 (Cont.)

(b) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by subsection (14) of this section.

(ii) This record shall include:

(A) The name, Social Security number, and description of duties of the employee;

(B) A copy of the physician's written opinions;

(C) Results of any exposure monitoring done for that employee and the representative exposure levels supplied to the physician; and

(D) Any employee medical complaints related to exposure to inorganic arsenic.

(iii) The employer shall in addition keep, or assure that the examining physician keeps, the following medical records:

(A) A copy of the medical examination results including medical and work history required under subsection (14) of this section;

(B) A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information;

(C) The initial x-ray;

(D) The x-rays for the most recent five years; and

(E) Any x-rays with a demonstrated abnormality and all subsequent x-rays.

(iv) The employer shall maintain or assure that the physician maintains those medical records for at least forty years, or for the duration of employment, plus twenty years, whichever is longer.

(c) Availability.

(i) The employer shall make available upon request all records required to be maintained by subsection (17) of this section to the director for examination and copying.

(ii) Records required by this subsection shall be provided upon request to employees, designated representatives, and the assistant director in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217.

(iii) The employer shall make available upon request an employee's medical records and exposure records representative of that employee's exposure required to be maintained by subsection (17) of this section to the affected employee or former employee or to a physician designated by the affected employee or former employee.

WAC 296-62-07347 (Cont.)

(d) Transfer of records.

(i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by this section.

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records required to be maintained by this section for the prescribed period, these records shall be transmitted to the director.

(iii) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify the director at least three months prior to the disposal of such records and shall transmit those records to the director if he requests them within that period.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in WAC 296-62-05215.

(18) **Observation of monitoring.**

(a) Employee observation. The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to inorganic arsenic conducted pursuant to subsection (5) of this section.

(b) Observation procedures.

(i) Whenever observation of the monitoring of employee exposure to inorganic arsenic requires entry into an area where the use of respirators, protective clothing, or equipment is required, the employer shall provide the observer with and assure the use of such respirators, clothing, and such equipment, and shall require the observer to comply with all other applicable safety and health procedures.

(ii) Without interfering with the monitoring, observers shall be entitled to;

(A) Receive an explanation of the measurement procedures;

(B) Observe all steps related to the monitoring of inorganic arsenic performed at the place of exposure; and

(C) Record the results obtained or receive copies of the results when returned by the laboratory.

(19) **Appendices.** The information contained in the appendices to this section is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07347, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-17-094 (Order 99-01, § 296-62-07347, filed 08/17/99, effective 12/01/99. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (order 98-10) § 296-62-07347, filed 05/04/99, effective 09/01/99.] Statutory Authority: RCW 49.17.010, [49.17].040 and [49.17].050. 98-02-030, § 296-62-07347, filed 12/31/97, effective 1/31/98. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-62-07347, filed 7/20/94, effective 9/20/94. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), § 296-62-07347, filed 8/27/81; 81-16-015 (Order 81-20), § 296-62-07347, filed 7/27/81; 79-08-115 (Order 79-9), § 296-62-07347, filed 7/31/79; 79-02-037 (Order 79-1), § 296-62-07347, filed 1/23/79.]

WAC 296-62-07354 Appendices--Inorganic arsenic. The information in Appendices A, B, and C is not intended, by itself, to create any additional obligations not otherwise imposed by WAC 296-62-07347 nor detract from existing obligation.

WAC 296-62-07354 (Cont.)

(1) **Appendix A--Inorganic arsenic substance information sheet.**

(a) Substance identification.

(i) Substance. Inorganic arsenic.

(ii) Definition. Copper acetoarsenite, arsenic and all inorganic compounds containing arsenic except arsine, measured as arsenic (As).

(iii) Permissible exposure limit. Ten micrograms per cubic meter of air as determined as an average over an 8 hour period. No employee may be exposed to any skin or eye contact with arsenic trichloride or to skin or eye contact likely to cause skin or eye irritation.

(iv) Regulated areas. Only employees authorized by your employer should enter a regulated area.

(b) Health hazard data.

(i) Comments. The health hazard of inorganic arsenic is high.

(ii) Ways in which the chemical affects your body. Exposure to airborne concentrations of inorganic arsenic may cause lung cancer, and can be a skin irritant. Inorganic arsenic may also affect your body if swallowed. One compound in particular, arsenic trichloride, is especially dangerous because it can be absorbed readily through the skin. Because inorganic arsenic is a poison, you should wash your hands thoroughly prior to eating or smoking.

(c) Personal protective equipment and clothing.

(i) Respirators. Respirators will be provided by the employer at no cost to employees for routine use if the employer is in the process of implementing engineering and work-practice controls or where engineering and work-practice controls are not feasible or insufficient. Respirators must be worn for nonroutine activities or in emergency situations where there is likely to be exposure to levels of inorganic arsenic in excess of the permissible exposure limit. Since how well the respirator fits is very important, the employer is required to conduct fit tests to make sure the respirator seals properly when worn. These tests are simple and rapid and will be explained during training sessions.

(ii) Protective clothing. If work is in a regulated area, the employer is required to provide at no cost to employees, and it must be worn, appropriate, clean, protective clothing and equipment. The purpose of this equipment is to prevent the employee from taking home arsenic-contaminated dust and to protect the body from repeated skin contact with inorganic arsenic likely to cause skin irritation. This clothing shall include such items as coveralls or similar full-body clothing, gloves, shoes or coverlets, and aprons. Protective equipment should include face shields or vented goggles, where eye irritation may occur.

(d) Hygiene facilities and practices.

(i) The employer shall ensure that employees do not eat, drink, smoke, chew gum or tobacco, or apply cosmetics in the regulated area, except that drinking water is permitted. If work is in a regulated area, the employer is required to provide lunchrooms or other areas for these purposes.

WAC 296-62-07354 (Cont.)

(ii) If work is in a regulated area, the employer is required to provide showers, washing facilities, and change rooms. The employer shall ensure that employees wash faces and hands before eating and shower at the end of the work shift. Do not take used protective clothing out of change rooms without the employer's permission. The employer is required to provide for laundering or cleaning of the protective clothing.

(e) Signs and labels. The employer is required to post warning signs and labels for employee protection. Signs must be posted in regulated areas. The signs must warn that a cancer hazard is present, that only authorized employees may enter the area, and that no smoking or eating is allowed, and that respirators must be worn.

(f) Medical examinations. If exposure to arsenic is over the action level (5 µg/m^3) (including all persons working in regulated areas) at least 30 days per year, or employees have been exposed to arsenic for more than 10 years over the action level, the employer is required to provide employees with a medical examination. The examination shall be every 6 months for employees over 45 years old or with more than 10 years exposure over the action level and annually for other covered employees. The medical examination must include a medical history; a chest x-ray (annual requirement only); skin examination; and nasal examination. The examining physician will provide a written opinion to the employer containing the results of the medical exams. Employees should also receive a copy of this opinion. The physician must not tell the employer any conditions he detects unrelated to occupational exposure to arsenic but must tell employees those conditions.

(g) Observation of monitoring. The employer is required to monitor employee exposure to arsenic and employees or their representatives are entitled to observe the monitoring procedure. Employees are entitled to receive an explanation of the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, employees must also be provided with and must wear the protective clothing and equipment.

(h) Access to records. Employees or their representatives are entitled to records of employee exposure to inorganic arsenic upon request to the employer. Employee medical examination records can be furnished to employees' physician if employees request the employer to provide them.

(i) Training and notification. Additional information on all of these items plus training as to hazards of exposure to inorganic arsenic and the engineering and work-practice controls associated with employees' jobs will also be provided by the employer. If employees are exposed over the permissible exposure limit, the employer must inform employees of that fact and the actions to be taken to reduce employee exposure.

(2) **Appendix B--Substance technical guidelines.** Arsenic, arsenic trioxide, arsenic trichloride (3 examples)

(a) Physical and chemical properties

(i) Arsenic (metal)

(A) Formula: As

(B) Appearance: Gray metal

(C) Melting point: Sublimes without melting at 613C

(D) Specific gravity: (H_20 = 1):5.73.

WAC 296-62-07354 (Cont.)

(E) Solubility in water: Insoluble

(ii) Arsenic trioxide

(A) Formula: As_20_3, (As_40_6).

(B) Appearance: White powder

(C) Melting point: 315C

(D) Specific gravity: (H_20 = 1):3.74

(E) Solubility in water: 3.7 grams in 100cc of water at 20C

(iii) Arsenic trichloride (liquid)(Trichloride)

(A) Formula: AsC13

(B) Appearance: Colorless or pale yellow liquid

(C) Melting point: -8.5C

(D) Boiling point: 130.2C

(E) Specific gravity (1120 = 1) 2:16 at 20C

(F) Vapor Pressure: 10mm Hg at 23.5C.

(G) Solubility in water: Decomposes in water.

(b) Fire, explosion, and reactivity data.

(i) Fire: Arsenic trioxide and arsenic trichloride are nonflammable.

(ii) Reactivity:

(A) Conditions contributing to instability: Heat.

(B) Incompatibility: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.

(c) Monitoring and measurement procedures.

(i) Samples collected should be full shift (at least 7 hours) samples. Sampling should be done using a personal sampling pump at a flow rate of 2 liters per minute. Samples should be collected on 0.8 micrometer pore size membrane filter (37mm diameter). Volatile arsenicals such as arsenic trichloride can be most easily collected in a midget bubbler filled with 15 ml. of 0.1 N NaOH.

(ii) The method of sampling and analysis should have an accuracy of not less than ± 25 percent (with a confidence limit of 95 percent) for 10 micrograms per cubic meter of air (10 $\mu g/m^3$) and ± 35 percent (with a confidence limit of 95 percent) for concentrations of inorganic arsenic between 5 and 10 $\mu g/m^3$.

(3) **Appendix C--Medical surveillance guidelines.**

(a) General.

(i) Medical examinations are to be provided for all employees exposed to levels of inorganic arsenic above the action level (5 $\mu g/m^3$) for at least 30 days per year (which would include among others, all employees, who work in regulated areas). Examinations are also to be provided to all employees who have had 10 years or more exposure above the action level for more than 30 days per year while working for the present or predecessor employer though they may no longer be exposed above the level.

(ii) An initial medical examination is to be provided to all such employees by December 1, 1978. In addition, an initial medical examination is to be provided to all employees who are first assigned to areas in which worker exposure will probably exceed 5 $\mu g/m^3$ (after the effective date of this standard) at the time of initial assignment. In addition to its immediate diagnostic usefulness the initial examination will provide a baseline for comparing future test results. The initial examination must include as a minimum the following elements:

(A) A work and medical history, including a smoking history, and presence and degree of respiratory symptoms such as breathlessness, cough, sputum production, and wheezing;

(B) A 14-inch by 17-inch posterior-anterior chest x-ray and an International Labor Office UICC/Cincinnati (ILO U/C) rating;

(C) A nasal and skin examination; and

(D) Other examinations which the physician believes appropriate because of the employee's exposure to inorganic arsenic or because of required respirator use.

(iii) Periodic examinations are also to be provided to the employees listed above. The periodic examinations shall be given annually for those covered employees 45 years of age or less with fewer than 10 years employment in areas where employee exposure exceeds the action level (5 $\mu g/m^3$). Periodic examinations need not include sputum cytology and only an updated medical history is required.

(iv) Periodic examinations for other covered employees, shall be provided every 6 months. These examinations shall include all tests required in the initial examination, except that the medical history need only be updated.

(v) The examination contents are minimum requirements. Additional tests such as lateral and oblique x-rays or pulmonary function tests may be useful. For workers exposed to 3 arsenicals, copper acetoarsenite, potassium arsenite, or sodium arsenite, which are associated with lymphatic cancer, the examination should also include palpation of superficial lymph nodes and complete blood count.

WAC 296-62-07354 (Cont.)

(b) Noncarcinogenic effects.

(i) The WISHA standard is based on minimizing risk of exposed workers dying of lung cancer from exposure to inorganic arsenic. It will also minimize skin cancer from such exposures.

(ii) The following three sections quoted from "Occupational Diseases: A Guide to Their Recognition," Revised Edition, June 1977, National Institute for Occupational Safety and Health is included to provide information on the nonneoplastic effects of exposure to inorganic arsenic. Such effects should not occur if the WISHA standards are followed.

(A) Local--Trivalent arsenic compounds are corrosive to the skin. Brief contact has no effect but prolonged contact results in a local hyperemia and later vesicular or pustular eruption. The moist mucous membranes are most sensitive to the irritant action. Conjunctiva, moist and macerated areas of skin, the eyelids, the angles of the ears, nose, mouth, and respiratory mucosa are also vulnerable to the irritant effects. The wrists are common sites of dermatitis, as are the genitalia if personal hygiene is poor. Perforations of the nasal septum may occur. Arsenic trioxide and pentoxide are capable of producing skin sensitization and contact dermatitis. Arsenic is also capable of producing keratoses, especially of the palms and soles.

(B) Systemic.

(I) The acute toxic effects of arsenic are generally seen following ingestion of inorganic arsenical compounds. This rarely occurs in an industrial setting. Symptoms develop within 1/2 to 4 hours following ingestion and are usually characterized by constriction of the throat followed by dysphagia, epigastric pain, vomiting, and watery diarrhea. Blood may appear in vomitus and stools. If the amount ingested is sufficiently high, shock may develop due to severe fluid loss, and death may ensue in 24 hours. If the acute effects are survived, exfoliative dermatitis and peripheral neuritis may develop.

(II) Cases of acute arsenical poisoning due to inhalation are exceedingly rare in industry. When it does occur, respiratory tract symptoms - cough, chest pain, dyspnea - giddiness, headache, and extreme general weakness precede gastrointestinal symptoms. The acute toxic symptoms of trivalent arsenical poisoning are due to severe inflammation of the mucous membranes and greatly increased permeability of the blood capillaries.

(III) Chronic arsenical poisoning due to ingestion is rare and generally confined to patients taking prescribed medications. However, it can be a concomitant of inhaled inorganic arsenic from swallowed sputum and improper eating habits. Symptoms are weight loss, nausea and diarrhea alternating with constipation, pigmentation and eruption of the skin, loss of hair, and peripheral neuritis. Chronic hepatitis and cirrhosis have been described. Polyneuritis may be the salient feature, but more frequently there are numbness and parasthenias of "glove and stocking" distribution. The skin lesions are usually melanotic and keratotic and may occasionally take the form of an intradermal cancer of the squamous cell type, but without infiltrative properties. Horizontal white lines (striations) on the fingernails and toenails are

commonly seen in chronic arsenical poisoning and are considered to be a diagnostic accompaniment of arsenical polyneuritis.

WAC 296-62-07354 (Cont.)

(IV) Inhalation of inorganic arsenic compounds is the most common cause of chronic poisoning in the industrial situation. This condition is divided into three phases based on signs and symptoms.

(V) First phase: The worker complains of weakness, loss of appetite, some nausea, occasional vomiting, a sense of heaviness in the stomach, and some diarrhea.

(VI) Second phase: The worker complains of conjunctivitis, a catarrhal state of the mucous membranes of the nose, larynx, and respiratory passage. Coryza, hoarseness, and mild tracheobronchitis may occur. Perforation of the nasal septum is common, and is probably the most typical lesion of the upper respiratory tract in occupational exposure to arsenical dust. Skin lesions, eczematoid and allergic in type, are common.

(VII) Third phase: The worker complains of symptoms of peripheral neuritis, initially of hands and feet, which is essentially sensory. In more severe cases, motor paralyses occur; the first muscles affected are usually the toe extensors and the peronei. In only the most severe cases will paralysis of flexor muscles of the feet or of the extensor muscles of hands occur.

(VIII) Liver damage from chronic arsenical poisoning is still debated, and as yet the question is unanswered. In cases of chronic and acute arsenical poisoning, toxic effects to the myocardium have been reported based on EKG changes. These findings, however, are now largely discounted and the EKG changes are ascribed to electrolyte disturbances concomitant with arsenicalism. Inhalation of arsenic trioxide and other inorganic arsenical dusts does not give rise to radiological evidence or pneumoconiosis. Arsenic does have a depressant effect upon the bone marrow, with disturbances of both erythropoiesis and myclopoiesis.

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[Statutory Authority: RCW 49.17.010, .040, .050. 99-17-094 (Order 99-01, § 296-62-07347, filed 08/17/99, effective 12/01/99. Statutory Authority: RCW 49.17.010, [49.17].040 and [49.17].050. 98-02-030, § 296-62-07354, filed 12/31/97, effective 1/31/98. Statutory Authority: Chapter 49.17 RCW. 90-20-091 (Order 90-14), § 296-62-07354, filed 10/1/90, effective 11/15/90.]

WAC 296-62-07355 Ethylene oxide. Scope and application.

(1) WAC 296-62-07355 through 296-62-07389 applies to all occupational exposures to ethylene oxide (EtO), Chemical Abstracts Service Registry No. 75-21-8, except as provided in subsection (2) of this section.

(2) WAC 296-62-07355 through 296-62-07389 does not apply to the processing, use, or handling of products containing EtO where objective data are reasonably relied upon that demonstrate that the product is not capable of releasing EtO in airborne concentrations at or above the action level, and may not reasonably be foreseen to release EtO in excess of the excursion limit, under the expected conditions of processing, use, or handling that will cause the greatest possible release.

(3) Where products containing EtO are exempted under subsection (2) of this section, the employer shall maintain records of the objective data supporting that exemption and the basis for the employer's reliance on the data, as provided in WAC 296-62-07375(1).

[Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), § 296-62-07355, filed 11/22/91, effective 12/24/91;88-23-054 (Order 88-25), § 296-62-07355, filed 11/14/88; 87-24-051 (Order 87-24), § 296-62-07355, filed 11/30/87.]

WAC 296-62-07357 Definitions. For the purpose of WAC 296-62-07355 through 296-62-07389, the following definitions shall apply:

(1) **"Action level"** means a concentration of airborne EtO of 0.5 ppm calculated as an eight-hour time-weighted average.

(2) **"Authorized person"** means any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees for the purpose of exercising the right to observe monitoring and measuring procedures under WAC 296-62-07377, or any other person authorized by chapter 49.17 RCW or regulations issued under chapter 49.17 RCW.

(3) **"Director"** means the director of the department of labor and industries, or designee.

(4) **"Emergency"** means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that is likely to or does result in an unexpected significant release of EtO.

(5) **"Employee exposure"** means exposure to airborne EtO which would occur if the employee were not using respiratory protective equipment.

(6) **"Ethylene oxide"** or **"EtO"** means the three-membered ring organic compound with chemical formula C_2H_4O.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07357, filed 11/30/87.]

WAC 296-62-07359 Permissible exposure limits (PEL).

(1) Eight-hour time-weighted average (TWA). The employer shall ensure that no employee is exposed to an airborne concentration of EtO in excess of one part EtO per million parts of air (1 ppm) as an eight-hour time-weighted average. (Eight-hour TWA.)

(2) Excursion limit. The employer shall ensure that no employee is exposed to an airborne concentration of EtO in excess of five parts of EtO per million parts of air (5 ppm) as averaged over a sampling period of fifteen minutes.

[Statutory Authority: Chapter 49.17 RCW. 88-23-054 (Order 88-25), § 296-62-07359, filed 11/14/88; 87-24-051 (Order 87-24), § 296-62-07359, filed 11/30/87.]

WAC 296-62-07361 Exposure monitoring.

(1) General.

WAC 296-62-07361 (Cont.)

(a) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the eight-hour TWA and fifteen-minute short-term exposures of each employee.

(b) Representative eight-hour TWA employee exposure shall be determined on the basis of one or more samples representing full-shift exposure for each shift for each job classification in each work area. Representative fifteen-minute short-term employee exposures shall be determined on the basis of one or more samples representing fifteen-minute exposures associated with operations that are most likely to produce exposures above the excursion limit for each shift for each job classification in each work area.

(c) Where the employer can document that exposure levels are equivalent for similar operations in different work shifts, the employer need only determine representative employee exposure for that operation during one shift.

(2) Initial monitoring.

(a) Each employer who has a workplace or work operation covered by WAC 296-62-07355 through 296-62-07389, except as provided in WAC 296-62-07355(2) or (b) of this subsection, shall perform initial monitoring to determine accurately the airborne concentrations of EtO to which employees may be exposed.

(b) Where the employer has monitored after June 15, 1983, and the monitoring satisfies all other requirements of WAC 296-62-07355 through 296-62-07389, the employer may rely on such earlier monitoring results to satisfy the requirements of (a) of this subsection.

(c) Where the employer has previously monitored for the excursion limit and the monitoring satisfies all other requirements of this section, the employer may rely on such earlier monitoring results to satisfy the requirements of (a) of this subsection.

(3) Monitoring frequency (periodic monitoring).

(a) If the monitoring required by subsection (2) of this section reveals employee exposure at or above the action level but at or below the eight-hour TWA, the employer shall repeat such monitoring for each such employee at least every six months.

(b) If the monitoring required by subsection (2)(a) of this section reveals employee exposure above the eight-hour TWA, the employer shall repeat such monitoring for each such employee at least every three months.

(c) The employer may alter the monitoring schedule from quarterly to semiannually for any employee for whom two consecutive measurements taken at least seven days apart indicate that the employee's exposure has decreased to or below the eight-hour TWA.

(d) If the monitoring required by subsection (2)(a) of this section reveals employee exposure above the fifteen-minute excursion limit, the employer shall repeat such monitoring for each such employee at least every three months, and more often as necessary to evaluate the employee's short-term exposures.

WAC 296-62-07361 (Cont.)

(4) **Termination of monitoring.**

(a) If the initial monitoring required by subsection (2)(a) of this section reveals employee exposure to be below the action level, the employer may discontinue TWA monitoring for those employees whose exposures are represented by the initial monitoring.

(b) If the periodic monitoring required by subsection (3) of this section reveals that employee exposures, as indicated by at least two consecutive measurements taken at least seven days apart, are below the action level, the employer may discontinue TWA monitoring for those employees whose exposures are represented by such monitoring.

(c) If the initial monitoring required by subsection (2)(a) of this section reveals the employee exposure to be at or below the excursion limit, the employer may discontinue excursion limit monitoring for those employees whose exposures are represented by the initial monitoring.

(d) If the periodic monitoring required by subsection (3) of this section reveals that employee exposures, as indicated by at least two consecutive measurements taken at least seven days apart, are at or below the excursion limit, the employer may discontinue excursion limit monitoring for those employees whose exposures are represented by such monitoring.

(5) **Additional monitoring.** Notwithstanding the provisions of subsection (4) of this section, the employer shall institute the exposure monitoring required under subsections (2)(a) and (3) of this section whenever there has been a change in the production, process, control equipment, personnel or work-practices that may result in new or additional exposures to EtO or when the employer has any reason to suspect that a change may result in new or additional exposures.

(6) **Accuracy of monitoring.**

(a) Monitoring shall be accurate, to a confidence level of ninety-five percent, to within plus or minus twenty-five percent for airborne concentrations of EtO at the 1 ppm TWA and to within plus or minus thirty-five percent for airborne concentrations of EtO at the action level of 0.5 ppm.

(b) Monitoring shall be accurate, to a confidence level of ninety-five percent, to within plus or minus thirty-five percent for airborne concentrations of EtO at the excursion limit.

(7) **Employee notification of monitoring results.**

(a) The employer shall, within fifteen working days after the receipt of the results of any monitoring performed under WAC 296-62-07355 through 296-62-07389, notify the affected employee of these results in writing either individually or by posting of results in an appropriate location that is accessible to affected employees.

(b) The written notification required by (a) of this subsection shall contain the corrective action being taken by the employer to reduce employee exposure to or below the TWA and/or excursion limit, wherever monitoring results indicated that the TWA and/or excursion limit has been exceeded.

[Statutory Authority: Chapter 49.17 RCW. 88-23-054 (Order 88-25), § 296-62-07361, filed 11/14/88; 87-24-051 (Order 87-24), § 296-62-07361, filed 11/30/87.]

WAC 296-62-07363 Regulated areas.

(1) The employer shall establish a regulated area wherever occupational exposures to airborne concentrations of EtO may exceed the TWA or wherever the EtO concentration exceeds or can reasonably be expected to exceed the excursion limit.

WAC 296-62-07363 (Cont.)

(2) Access to regulated areas shall be limited to authorized persons.

(3) Regulated areas shall be demarcated in any manner that minimizes the number of employees within the regulated area.

[Statutory Authority: Chapter 49.17 RCW. 88-23-054 (Order 88-25), § 296-62-07363, filed 11/14/88; 87-24-051 (Order 87-24), § 296-62-07363, filed 11/30/87.]

WAC 296-62-07365 Methods of compliance.

(1) **Engineering controls and work-practices.**

(a) The employer shall institute engineering controls and work-practices to reduce and maintain employee exposure to or below the TWA and to or below the excursion limit, except to the extent that such controls are not feasible.

(b) Wherever the feasible engineering controls and work-practices that can be instituted are not sufficient to reduce employee exposure to or below the TWA and to or below the excursion limit, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of WAC 296-62-07367.

(c) Engineering controls are generally infeasible for the following operations: Collection of quality assurance sampling from sterilized materials removal of biological indicators from sterilized materials: Loading and unloading of tank cars; changing of ethylene oxide tanks on sterilizers; and vessel cleaning. For these operations, engineering controls are required only where the director demonstrates that such controls are feasible.

(2) **Compliance program.**

(a) Where the TWA or excursion limit is exceeded, the employer shall establish and implement a written program to reduce employee exposure to or below the TWA and to or below the excursion limit by means of engineering and work-practice controls, as required by subsection (1) of this section, and by the use of respiratory protection where required or permitted under WAC 296-62-07355 through 296-62-07389.

(b) The compliance program shall include a schedule for periodic leak detection surveys and a written plan for emergency situations, as specified in WAC 296-62-07369 (1)(a).

(c) Written plans for a program required in this subsection shall be developed and furnished upon request for examination and copying to the director, affected employees and designated employee representatives. Such plans shall be reviewed at least every twelve months, and shall be updated as necessary to reflect significant changes in the status of the employer's compliance program.

(d) The employer shall not implement a schedule of employee rotation as a means of compliance with the TWA or excursion limit.

[Statutory Authority: Chapter 49.17 RCW. 88-23-054 (Order 88-25), § 296-62-07365, filed 11/14/88; 87-24-051 (Order 87-24), § 296-62-07365, filed 11/30/87.]

WAC 296-62-07367 Respiratory protection and personal protective equipment.

(1) **General.** For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of WAC 296-62-07355 through 296-62-07389. Respirators must be used during:

WAC 296-62-07367 (Cont.)

(a) Periods necessary to install or implement feasible engineering and work-practice controls;

(b) Work operations, such as maintenance and repair activities, vessel cleaning, or other activities, for which engineering and work-practice controls are not feasible;

(c) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the TWA or excursion limit;

(d) Emergencies.

(2) **Respirator program.** The employer must establish, implement, and maintain a respiratory protection program as required in chapter 296-62 WAC, Part E, (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(3) **Respirator selection.** The employer must select the appropriate respirator from Table 1 of this section.

Table 1.-Minimum Requirements for Respiratory Protection for Airborne EtO

Condition of use or concentration of airborne EtO (ppm)	Minimum required respirator
Equal to or less than 50	(a) Full facepiece respirator with EtO approved canister, front-or back-mounted.
Equal to or less than 2,000	(a) Positive-pressure supplied-air respirator, equipped with full facepiece, hood or helmet, or
	(b) Continuous-flow supplied-air respirator (positive pressure) equipped with hood, helmet or suit.
Concentration above 2,000 or unknown concentration (such as in emergencies)	(a) Positive-pressure self-contained breathing apparatus (SCBA), equipped with full facepiece, or (b) Positive-pressure full facepiece supplied-air respirator equipped with an auxiliary positive-pressure self-contained breathing apparatus.
Firefighting	(a) Positive-pressure self-contained breathing apparatus equipped with full facepiece.
Escape	(a) Any respirator described above.

Note: Respirators approved for use in higher concentrations are permitted to be used in lower concentrations.

(4) **Protective clothing and equipment.** Where employees could have eye or skin contact with EtO or EtO solutions, the employer must select and provide, at no cost to the employee, appropriate protective clothing or other equipment in accordance with WAC 296-800-160, and to protect any area of the body that may come in contact with liquid EtO or EtO in solution, and must ensure that the employee wears the protective clothing and equipment provided.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07367, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07367, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 94-20-057 (Order 94-16), § 296-62-07367, filed 9/30/94, effective 11/20/94; 88-23-054 (Order 88-25), § 296-62-07367, filed 11/14/88; 87-24-051 (Order 87-24), § 296-62-07367, filed 11/30/87.]

WAC 296-62-07369 Emergency situations.

(1) **Written plan.**

(a) A written plan for emergency situations shall be developed for each workplace where there is a possibility of an emergency. Appropriate portions of the plan shall be implemented in the event of an emergency.

(b) The plan shall specifically provide that employees engaged in correcting emergency conditions shall be equipped with respiratory protection as required by WAC 296-62-07367 until the emergency is abated.

(c) The plan shall include the elements prescribed in WAC 296-24-567, "Employee emergency plans and fire prevention plans."

(2) Alerting employees. Where there is a possibility of employee exposure to EtO due to an emergency, means shall be developed to alert potentially affected employees of such occurrences promptly. Affected employees shall be immediately evacuated from the area in the event that an emergency occurs.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07369, filed 05/04/99, effective 09/01/99.]
Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07369, filed 11/30/87.]

WAC 296-62-07371 Medical surveillance.

(1) **General.**

(a) Employees covered.

(i) The employer shall institute a medical surveillance program for all employees who are or may be exposed to EtO at or above the action level, without regard to the use of respirators, for at least thirty days a year.

(ii) The employer shall make available medical examinations and consultations to all employees who have been exposed to EtO in an emergency situation.

(b) Examination by a physician. The employer shall ensure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and are provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(2) **Medical examinations and consultations.**

(a) Frequency. The employer shall make available medical examinations and consultations to each employee covered under subsection (1)(a) of this section on the following schedules:

(i) Prior to assignment of the employee to an area where exposure may be at or above the action level for at least thirty days a year.

(ii) At least annually each employee exposed at or above the action level for at least thirty days in the past year.

(iii) At termination of employment or reassignment to an area where exposure to EtO is not at or above the action level for at least thirty days a year.

(iv) As medically appropriate for any employee exposed during an emergency.

WAC 296-62-07371 (Cont.)

(v) As soon as possible, upon notification by an employee either (A) that the employee has developed signs or symptoms indicating possible overexposure to EtO, or (B) that the employee desires medical advice concerning the effects of current or past exposure to EtO on the employee's ability to produce a healthy child.

(vi) If the examining physician determines that any of the examinations should be provided more frequently than specified, the employer shall provide such examinations to affected employees at the frequencies recommended by the physician.

(b) Content

(i) Medical examinations made available pursuant to (a)(i) through (iv) of this subsection shall include:

(A) A medical and work history with special emphasis directed to symptoms related to the pulmonary, hematologic, neurologic, and reproductive systems and to the eyes and skin.

(B) A physical examination with particular emphasis given to the pulmonary, hematologic, neurologic, and reproductive systems and to the eyes and skin.

(C) A complete blood count to include at least a white cell count (including differential cell count), red cell count, hematocrit, and hemoglobin.

(D) Any laboratory or other test which the examining physician deems necessary by sound medical practice.

(ii) The content of medical examinations or consultation made available pursuant to (a)(i)(v) of this subsection shall be determined by the examining physician, and shall include pregnancy testing or laboratory evaluation of fertility, if requested by the employee and deemed appropriate by the physician.

(3) **Information provided to the physician.** The employer shall provide the following information to the examining physician:

(a) A copy of WAC 296-62-07355 through 296-62-07389.

(b) A description of the affected employee's duties as they relate to the employee's exposure.

(c) The employee's representative exposure level or anticipated exposure level.

(d) A description of any personal protective and respiratory equipment used or to be used.

(e) Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.

(4) **Physician's written opinion.**

(a) The employer shall obtain a written opinion from the examining physician. This written opinion shall contain the results of the medical examination and shall include:

WAC 296-62-07371 (Cont.)

(i) The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to EtO;

(ii) Any recommended limitations on the employee or upon the use of personal protective equipment such as clothing or respirators; and

(iii) A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions resulting from EtO exposure that require further explanation or treatment.

(b) The employer shall instruct the physician not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to EtO.

(c) The employer shall provide a copy of the physician's written opinion to the affected employee within fifteen days from its receipt.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07371, filed 11/30/87.]

WAC 296-62-07373 Communication of EtO hazards to employees.

(1) **Signs and labels.**

(a) The employer shall post and maintain legible signs demarcating regulated areas and entrances or accessways to regulated areas that bear the following legend:

DANGER
ETHYLENE OXIDE
CANCER HAZARD AND REPRODUCTIVE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING MAY BE REQUIRED
TO BE WORN IN THIS AREA

(b) The employer shall ensure that precautionary labels are affixed to all containers of EtO whose contents are capable of causing employee exposure at or above the action level or whose contents may reasonably be foreseen to cause employee exposure above the excursion limit, and that the labels remain affixed when the containers of EtO leave the workplace. For the purpose of this subsection, reaction vessels, storage tanks, and pipes or piping systems are not considered to be containers. The labels shall comply with the requirements of WAC 296-800-170 of WISHA's chemical hazard communication standard, and shall include the following legend:

(i)

DANGER
CONTAINS ETHYLENE OXIDE
CANCER HAZARD AND REPRODUCTIVE HAZARD, and

(ii) A warning statement against breathing airborne concentrations of EtO.

(c) The labeling requirements under WAC 296-62-07355 through 296-62-07389 do not apply where EtO is used as a pesticide, as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 et seq.), when it is labeled pursuant to that act and regulations issued under that act by the Environmental Protection Agency.

WAC 296-62-07373 (Cont.)

(2) **Material safety data sheets.** Employers who are manufacturers or importers of EtO shall comply with the requirements regarding development of material safety data sheets as specified in WAC 296-62-05413 of the hazard communication standard.

(3) **Information and training.**

(a) The employer shall provide employees who are potentially exposed to EtO at or above the action level or above the excursion limit with information and training on EtO at the time of initial assignment and at least annually thereafter.

(b) Employees shall be informed of the following:

(i) The requirements of WAC 296-62-07353 through 296-62-07389 with an explanation of its contents, including Appendices A and B;

(ii) Any operations in their work area where EtO is present;

(iii) The location and availability of the written EtO final rule; and

(iv) The medical surveillance program required by WAC 296-62-07371 with an explanation of the information in Appendix C.

(c) Employee training shall include at least:

(i) Methods and observations that may be used to detect the presence or release of EtO in the work area (such as monitoring conducted by the employer, continuous monitoring devices, etc.);

(ii) The physical and health hazards of EtO;

(iii) The measures employees can take to protect themselves from hazards associated with EtO exposure, including specific procedures the employer has implemented to protect employees from exposure to EtO, such as work-practices, emergency procedures, and personal protective equipment to be used; and

(iv) The details of the hazard communication program developed by the employer, including an explanation of the labeling system and how employees can obtain and use the appropriate hazard information.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07385, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 88-23-054 (Order 88-25), § 296-62-07373, filed 11/14/88; 87-24-051 (Order 87-24), § 296-62-07373, filed 11/30/87.]

WAC 296-62-07375 Recordkeeping.

(1) **Objective data for exempted operations.**

(a) Where the processing, use, or handling of products made from or containing EtO are exempted from other requirements of WAC 296-62-07355 through 296-62-07389 under WAC 296-62-07355, or where objective data have been relied on in lieu of initial monitoring under WAC 296-62-07361 (2)(b), the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(b) This record shall include at least the following information:

WAC 296-62-07375 (Cont.)

(i) The product qualifying for exemption;

(ii) The source of the objective data;

(iii) The testing protocol, results of testing, and/or analysis of the material for the release of EtO;

(iv) A description of the operation exempted and how the data support the exemption; and

(v) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(c) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(2) **Exposure measurements.**

(a) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to EtO as prescribed in WAC 296-62-07361.

(b) This record shall include at least the following information:

(i) The date of measurement;

(ii) The operation involving exposure to EtO which is being monitored;

(iii) Sampling and analytical methods used and evidence of their accuracy;

(iv) Number, duration, and results of samples taken;

(v) Type of protective devices worn, if any; and

(vi) Name, Social Security number and exposure of the employees whose exposures are represented.

(c) The employer shall maintain this record for at least thirty years, in accordance with WAC 296-62-05207.

(3) **Medical surveillance.**

(a) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by WAC 296-62-07371 (1)(a), in accordance with WAC 296-62-05207.

(b) The record shall include at least the following information:

(i) The name and Social Security number of the employee;

(ii) Physicians' written opinions;

(iii) Any employee medical complaints related to exposure to EtO; and

(iv) A copy of the information provided to the physician as required by WAC 296-62-07371(3).

WAC 296-62-07375 (Cont.)

(c) The employer shall ensure that this record is maintained for the duration of employment plus thirty years, in accordance with WAC 296-62-05207.

(4) **Availability.**

(a) The employer, upon written request, shall make all records required to be maintained by WAC 296-62-07355 through 296-62-07389 available to the director for examination and copying.

(b) The employer, upon request, shall make any exemption and exposure records required by WAC 296-62-07377 (1) and (2) available for examination and copying to affected employees, former employees, designated representatives and the director, in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217.

(c) The employer, upon request, shall make employee medical records required by subsection (3) of this section available for examination and copying to the subject employee, anyone having the specific written consent of the subject employee, and the director, in accordance with WAC 296-62-052.

(5) **Transfer of records.**

(a) The employer shall comply with the requirements concerning transfer of records set forth in WAC 296-62-05215.

(b) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the director at least ninety days prior to disposal and transmit them to the director.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07375, filed 11/30/87.]

WAC 296-62-07377 Observation of monitoring.

(1) **Employee observation.** The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to EtO conducted in accordance with WAC 296-62-07361.

(2) **Observation procedures.** When observation of the monitoring of employee exposure to EtO requires entry into an area where the use of protective clothing or equipment is required, the observer shall be provided with and be required to use such clothing and equipment and shall comply with all other applicable safety and health procedures.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07377, filed 11/30/87.]

WAC 296-62-07381 Appendices. The information contained in the appendices is not intended by itself to create any additional obligations not otherwise imposed or to detract from any existing obligation.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), § 296-62-07381, filed 11/30/87.]

WAC 296-62-07383 Appendix A--Substance safety data sheet for ethylene oxide (nonmandatory).

(1) **Substance identification**

(a) Substance: Ethylene oxide (C_2H_4O).

(b) Synonyms: Dihydrooxirene, dimethylene oxide, EO, 1,2-epoxyethane, EtO, EtO, oxacyclopropane, oxane, oxidoethane, alpha/beta-oxidoethane, oxiran, oxirane.

WAC 296-62-07383 (Cont.)

(c) Ethylene oxide can be found as a liquid or vapor.

(d) EtO is used in the manufacture of ethylene glycol, surfactants, ethanolamines, glycol ethers, and other organic chemicals. EtO is also used as a sterilant and fumigant.

(e) Appearance and odor: Colorless liquid below 10.7°C (51.3°F) or colorless gas with ether-like odor detected at approximately 700 parts EtO per million parts of air (700 ppm).

(f) Permissible exposure: Exposure may not exceed 1 part EtO per million parts of air averaged over the 8-hour work day.

(2) **Health hazard data**

(a) Ethylene oxide can cause bodily harm if you inhale the vapor, if it comes into contact with your eyes or skin, or if you swallow it.

(b) Effects of overexposure:

(i) Ethylene oxide in liquid form can cause eye irritation and injury to the cornea, frostbite, and severe irritation and blistering of the skin upon prolonged or confined contact. Ingestion of EtO can cause gastric irritation and liver injury. Acute effects from inhalation of EtO vapors include respiratory irritation and lung injury, headache, nausea, vomiting, diarrhea, shortness of breath, and cyanosis (blue or purple coloring of skin). Exposure has also been associated with the occurrence of cancer, reproductive effects, mutagenic changes, neurotoxicity, and sensitization.

(ii) EtO has been shown to cause cancer in laboratory animals and has been associated with higher incidences of cancer in humans. Adverse reproductive effects and chromosome damage may also occur from EtO exposure.

(c) Reporting signs and symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to EtO.

(3) **Emergency first aid procedures**

(a) Eye exposure: If EtO gets into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper eyelids. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

(b) Skin exposure: If EtO gets on your skin, immediately wash the contaminated skin with water. If EtO soaks through your clothing, especially your shoes, remove the clothing immediately and wash the skin with water using an emergency deluge shower. Get medical attention immediately. Thoroughly wash contaminated clothing before reusing. Contaminated leather shoes or other leather articles should not be reused and should be discarded.

(c) Inhalation: If large amounts of EtO are inhaled, the exposed person must be moved to fresh air at once. If breathing has stopped, perform cardiopulmonary resuscitation. Keep the affected person warm and at rest. Get medical attention immediately.

WAC 296-62-07383 (Cont.)

(d) Swallowing: When EtO has been swallowed, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him or her touch the back of the throat with his or her finger. Do not make an unconscious person vomit. Get medical attention immediately.

(e) Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, attempt rescue only after notifying at least one other person of the emergency and putting into effect established emergency procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the location of the emergency equipment before the need arises.

(4) **Respirators and protective clothing**

(a) Respirators:

(i) You may be required to wear a respirator for nonroutine activities, in emergencies, while your employer is in the process of reducing EtO exposure through engineering controls, and in areas where engineering controls are not feasible. Only air supplied positive-pressure, full-facepiece respirators are approved for protection against EtO. If air-purifying respirators are worn in the future, they must have a label issued by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84 stating that the respirators have been certified for use with ethylene oxide. For effective protection, respirators must fit your face and head snugly. Respirators must not be loosened or removed in work situations where their use is required.

(ii) EtO does not have a detectable odor except at levels well above the permissible exposure limits. If you can smell EtO while wearing a respirator, proceed immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

(b) Protective clothing:

(i) You may be required to wear impermeable clothing, gloves, a face shield, or other appropriate protective clothing to prevent skin contact with liquid EtO or EtO-containing solutions. Where protective clothing is required, your employer must provide clean garments to you as necessary to assure that the clothing protects you adequately.

(ii) Replace or repair protective clothing that has become torn or otherwise damaged.

(iii) EtO must never be allowed to remain on the skin. Clothing and shoes which are not impermeable to EtO should not be allowed to become contaminated with EtO, and if they do, the clothing should be promptly removed and decontaminated. Contaminated leather shoes should be discarded. Once EtO penetrates shoes or other leather articles, they should not be worn again.

(c) Eye protection: You must wear splashproof safety goggles in areas where liquid EtO or EtO-containing solutions may contact your eyes. In addition, contact lenses should not be worn in areas where eye contact with EtO can occur.

WAC 296-62-07383 (Cont.)

(5) **Precautions for safe use, handling, and storage**

(a) EtO is a flammable liquid, and its vapors can easily form explosive mixtures in air.

(b) EtO must be stored in tightly closed containers in a cool, well-ventilated area, away from heat, sparks, flames, strong oxidizers, alkalines, and acids, strong bases, acetylide forming metals such as copper, silver, mercury and their alloys.

(c) Sources of ignition such as smoking material, open flames and some electrical devices are prohibited wherever EtO is handled, used, or stored in a manner that could create a potential fire or explosion hazard.

(d) You should use nonsparking tools when opening or closing metal containers of EtO, and containers must be bonded and grounded in the rare instances in which liquid EtO is poured or transferred.

(e) Impermeable clothing wet with liquid EtO or EtO-containing solutions may be easily ignited. If you are wearing impermeable clothing and are splashed with liquid EtO or EtO-containing solution, you should immediately remove the clothing while under an emergency deluge shower.

(f) If your skin comes into contact with liquid EtO or EtO-containing solutions, you should immediately remove the EtO using an emergency deluge shower.

(g) You should not keep food, beverages, or smoking materials in regulated areas where employee exposures are above the permissible exposure limits.

(h) Fire extinguishers and emergency deluge showers for quick drenching should be readily available, and you should know where they are and how to operate them.

(i) Ask your supervisor where EtO is used in your work area and for any additional plant safety and health rules.

(6) **Access to information.**

(a) Each year, your employer is required to inform you of the information contained in this standard and appendices for EtO. In addition, your employer must instruct you in the proper work-practices for using EtO emergency procedures, and the correct use of protective equipment.

(b) Your employer is required to determine whether you are being exposed to EtO. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being overexposed, he or she is required to inform you of the actions which are being taken to reduce your exposure to within permissible exposure limits.

(c) Your employer is required to keep records of your exposures and medical examinations. These exposure records must be kept by the employer for at least thirty years. Medical records must be kept for the period of your employment plus thirty years.

(d) Your employer is required to release your exposure and medical records to your physician or designated representative upon your written request.

WAC 296-62-07383 (Cont.)

(7) **Sterilant use of EtO in hospitals and health care facilities.**

(a) This section of Appendix A, for informational purposes, sets forth EPA's recommendations for modifications in workplace design and practice in hospitals and health care facilities for which the Environmental Protection Agency has registered EtO for uses as a sterilant or fumigant under the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. 136 et seq. These new recommendations, published in the Federal Register by EPA at 49 FR 15268, as modified in today's Register, are intended to help reduce the exposure of hospital and health care workers to EtO to 1 ppm. EPA's recommended workplace design and workplace practice are as follows:

(i) Workplace design

(A) Installation of gas line hand valves. Hand valves must be installed on the gas supply line at the connection to the supply cylinders to minimize leakage during cylinder change.

(B) Installation of capture boxes. Sterilizer operations result in a gas/water discharge at the completion of the process. This discharge is routinely piped to a floor drain which is generally located in an equipment or an adjacent room. When the floor drain is not in the same room as the sterilizer and workers are not normally present, all that is necessary is that the room be well ventilated.

(C) The installation of a “capture box” will be required for those work place layouts where the floor drain is located in the same room as the sterilizer or in a room where workers are normally present. A “capture box” is a piece of equipment that totally encloses the floor drain where the discharge from the sterilizer is pumped. The “capture box” is to be vented directly to a nonrecirculating or dedicated ventilation system. Sufficient air intake should be allowed at the bottom of the box to handle the volume of air that is ventilated from the top of the box. The “capture box” can be made of metal, plastic, wood or other equivalent material. The box is intended to reduce levels of EtO discharged into the work room atmosphere. The use of a “capture box” is not required if: (I) The vacuum pump discharge floor drain is located in a well ventilated equipment or other room where workers are not normally present or (II) the water sealed vacuum pump discharges directly to a closed sealed sewer line (check local plumbing codes).

(D) If it is impractical to install a vented “capture box” and a well ventilated equipment or other room is not feasible, a box that can be sealed over the floor drain may be used if: (I) The floor drain is located in a room where workers are not normally present and EtO cannot leak into an occupied area, and (II) the sterilizer in use is less than 12 cubic feet in capacity (check local plumbing codes).

(ii) Ventilation of aeration units.

(A) Existing aeration units. Existing units must be vented to a nonrecirculating or dedicated system or vented to an equipment or other room where workers are not normally present and which is well ventilated. Aerator units must be positioned as close as possible to the sterilizer to minimize the exposure from the off-gassing of sterilized items.

WAC 296-62-07383 (Cont.)

(B) Installation of new aerator units (where none exist). New aerator units must be vented as described above for existing aerators. Aerators must be in place by July 1, 1986.

(iii) Ventilation during cylinder change. Workers may be exposed to short but relatively high levels of EtO during the change of gas cylinders. To reduce exposure from this route, users must select one of three alternatives designed to draw off gas that may be released when the line from the sterilizer to the cylinder is disconnected:

(A) Location of cylinders in a well ventilated equipment room or other room where workers are not normally present.

(B) Installation of a flexible hose (at least four inches in diameter) to a nonrecirculating or dedicated ventilation system and located in the area of cylinder change in such a way that the hose can be positioned at the point where the sterilizer gas line is disconnected from the cylinder.

(C) Installation of a hood that is part of a nonrecirculating or dedicated system and positioned no more than one foot above the point where the change of cylinders takes place.

(iv) Ventilation of sterilizer door area. One of the major sources of exposure to EtO occurs when the sterilizer door is opened following the completion of the sterilization process. In order to reduce this avenue of exposure, a hood or metal canopy closed on each end must be installed over the sterilizer door. The hood or metal canopy must be connected to a nonrecirculating or dedicated ventilation system or one that exhausts gases to a well ventilated equipment or other room where workers are not normally present. A hood or canopy over the sterilizer door is required for use even with those sterilizers that have a purge cycle and must be in place by July 1, 1986.

(v) Ventilation of sterilizer relief valve. Sterilizers are typically equipped with a safety relief device to release gas in case of increased pressure in the sterilizer. Generally, such relief devices are used on pressure vessels. Although these pressure relief devices are rarely opened for hospital and health care sterilizers, it is suggested that they be designed to exhaust vapor from the sterilizer by one of the following methods:

(A) Through a pipe connected to the outlet of the relief valve ventilated directly outdoors at a point high enough to be away from passers by, and not near any windows that open, or near any air conditioning or ventilation air intakes.

(B) Through a connection to an existing or new nonrecirculating or dedicated ventilation system.

(C) Through a connection to a well ventilated equipment or other room where workers are not normally present.

(vi) Ventilation systems. Each hospital and health care facility affected by this notice that uses EtO for the sterilization of equipment and supplies must have a ventilation system which enables compliance with the requirements of (a)(i)(B) through (v) of this subsection in the manner described in these sections and within the timeframes allowed. Thus, each affected hospital and health care facility must have or install a nonrecirculating or dedicated ventilation equipment or other room where workers are not normally present in which to vent EtO.

WAC 296-62-07383 (Cont.)

(vii) Installation of alarm systems. An audible and visual indicator alarm system must be installed to alert personnel of ventilation system failures, i.e., when the ventilation fan motor is not working.

(b) Workplace practices

(i) All the workplace practices discussed in this unit must be permanently posted near the door of each sterilizer prior to use by any operator.

(ii) Changing of supply line filters.

Filters in the sterilizer liquid line must be changed when necessary, by the following procedure:

(A) Close the cylinder valve and the hose valve.

(B) Disconnect the cylinder hose (piping) from the cylinder.

(C) Open the hose valve and bleed slowly into a proper ventilating system at or near the in-use supply cylinders.

(D) Vacate the area until the line is empty.

(E) Change the filter.

(F) Reconnect the lines and reverse the valve position.

(G) Check hoses, filters, and valves for leaks with a fluorocarbon leak detector (for those sterilizers using the eighty-eight percent chlorofluorocarbon, twelve percent ethylene oxide mixture (12/88)).

(iii) Restricted access area.

(A) Areas involving use of EtO must be designated as restricted access areas. They must be identified with signs or floor marks near the sterilizer door, aerator, vacuum pump floor drain discharge, and in-use cylinder storage.

(B) All personnel must be excluded from the restricted area when certain operations are in progress, such as discharging a vacuum pump, emptying a sterilizer liquid line, or venting a nonpurge sterilizer with the door ajar or other operations where EtO might be released directly into the face of workers.

(iv) Door opening procedures.

(A) Sterilizers with purge cycles. A load treated in a sterilizer equipped with a purge cycle should be removed immediately upon completion of the cycle (provided no time is lost opening the door after cycle is completed). If this is not done, the purge cycle should be repeated before opening door.

(B) Sterilizers without purge cycles. For a load treated in a sterilizer not equipped with a purge cycle, the sterilizer door must be ajar six inches for fifteen minutes, and then fully opened for at least another fifteen minutes before removing the treated load. The length of time of the second period should be established by

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peak monitoring for one hour after the two fifteen-minute periods suggested. If the level is above 10 ppm time-weighted average for eight hours, more time should be added to the second waiting period (door wide open). However, in no case may the second period be shortened to less than fifteen minutes.

(v) Chamber unloading procedures.

(A) Procedures for unloading the chamber must include the use of baskets or rolling carts, or baskets and rolling tables to transfer treated loads quickly, thus avoiding excessive contact with treated articles, and reducing the duration of exposures.

(B) If rolling carts are used, they should be pulled not pushed by the sterilizer operators to avoid offgassing exposure.

(vi) Maintenance. A written log should be instituted and maintained documenting the date of each leak detection and any maintenance procedures undertaken. This is a suggested use practice and is not required.

(vii) Leak detection. Sterilizer door gaskets, cylinder and vacuum piping, hoses, filters, and valves must be checked for leaks under full pressure with a Fluorocarbon leak detector (for 12/88 systems only) every two weeks by maintenance personnel. Also, the cylinder piping connections must be checked after changing cylinders. Particular attention in leak detection should be given to the automatic solenoid valves that control the flow of EtO to the sterilizer. Specifically, a check should be made at the EtO gasline entrance port to the sterilizer, while the sterilizer door is open and the solenoid valves are in a closed position.

(viii) Maintenance procedures. Sterilizer/aerator door gaskets, valves, and fittings must be replaced when necessary as determined by maintenance personnel in their biweekly checks; in addition, visual inspection of the door gaskets for cracks, debris, and other foreign substances should be conducted daily by the operator.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07383, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 88-14-108 (Order 88-11), § 296-62-07383, filed 7/6/88; 87-24-051 (Order 87-24), § 296-62-07383, filed 11/30/87.]

WAC 296-62-07385 Appendix B--Substance technical guidelines for ethylene oxide (nonmandatory).

(1) **Physical and chemical data:**

(a) Substance identification:

(i) Synonyms: Dihydrooxirene, dimethylene oxide, EO, 1,2-epoxyethane, EtO, EtO, oxacyclopropane, oxane, oxidoethane, alpha/beta-oxidoethane, oxiran, oxirane.

(ii) Formula: (C_2H_4O).

(iii) Molecular weight: 44.06.

(b) Physical data:

(i) Boiling point (760 mm Hg): 10.70°C (51.3°F);

(ii) Specific gravity (water = 1): 0.87 (at 20°C or 68°F);

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(iii) Vapor density (air = 1): 1.49;

(iv) Vapor pressure (at 20°C): 1,095 mm Hg;

(v) Solubility in water: Complete;

(vi) Appearance and odor: Colorless liquid; gas at temperature above 10.7°F or 51.3°C with ether-like odor above 700 ppm.

(2) **Fire, explosion, and reactivity hazard data:**

(a) Fire:

(i) Flash point; Less than 0°F (open cup);

(ii) Stability: Decomposes violently at temperatures above 800°F;

(iii) Flammable limits in air, percent by volume: Lower: 3, Upper: 100;

(iv) Extinguishing media: Carbon dioxide for small fires, polymer or alcohol foams for large fires;

(v) Special fire fighting procedures: Dilution of ethylene oxide with 23 volumes of water renders it nonflammable;

(vi) Unusual fire and explosion hazards: Vapors of EtO will burn without the presence of air or other oxidizers. EtO vapors are heavier than air and may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which EtO is being used.

(vii) For purposes of compliance with the requirements of WAC 296-24-330, EtO is classified as a flammable gas. For example, 7,500 ppm, approximately one-fourth of the lower flammable limit, would be considered to pose a potential fire and explosion hazard.

(viii) For purposes of compliance with WAC 296-24-585, EtO is classified as a Class B fire hazard.

(ix) For purpose of compliance with chapter 296-24 WAC Part L, and WAC 296-800-280, locations classified as hazardous due to the presence of EtO shall be Class I.

(b) Reactivity:

(i) Conditions contributing to instability: EtO will polymerize violently if contaminated with aqueous alkalies, amines, mineral acids, metal chlorides, or metal oxides. Violent decomposition will also occur at temperatures above 800°F;

(ii) Incompatibilities: Alkalines and acids;

(iii) Hazardous decomposition products: Carbon monoxide and carbon dioxide.

(3) **Spill, leak, and disposal procedures:**

(a) If EtO is spilled or leaked, the following steps should be taken:

(i) Remove all ignition sources.

(ii) The area should be evacuated at once and re-entered only after the area has been thoroughly ventilated and washed down with water.

(b) Persons not wearing appropriate protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.

(c) Waste disposal method: Waste material should be disposed of in a manner that is not hazardous to employees or to the general population. In selecting the method of waste disposal, applicable local, state, and federal regulations should be consulted.

(4) **Monitoring and measurement procedures:**

(a) Exposure above the permissible exposure limit:

(i) Eight-hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken with consecutive samples covering the full shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee.)

(ii) Monitoring techniques: The sampling and analysis under this section may be performed by collection of the EtO vapor on charcoal adsorption tubes or other composition adsorption tubes, with subsequent chemical analysis. Sampling and analysis may also be performed by instruments such as real time continuous monitoring systems, portable direct reading instruments, or passive dosimeters as long as measurements taken using these methods accurately evaluate the concentration of EtO in employees' breathing zones.

(iii) Appendix D describes the validated method of sampling and analysis which has been tested by OSHA for use with EtO. Other available methods are also described in Appendix D. The employer has the obligation of selecting a monitoring method which meets the accuracy and precision requirements of the standard under his/her unique field conditions. The standard requires that the method of monitoring should be accurate, to a 95 percent confidence level, to plus or minus 25 percent for concentrations of EtO at 1 ppm, and to plus or minus 35 percent for concentrations at 0.5 ppm. In addition to the method described in Appendix D, there are numerous other methods available for monitoring for EtO in the workplace. Details on these other methods have been submitted by various companies to the rulemaking record, and are available at the OSHA Docket Office.

(b) Since many of the duties relating to employee exposure are dependent on the results of measurement procedures, employers should assure that the evaluation of employee exposures is performed by a technically qualified person.

(5) **Protective clothing and equipment:**

(a) Employees should be provided with and be required to wear appropriate protective clothing wherever there is significant potential for skin contact with liquid EtO or EtO-containing solutions. Protective clothing shall include impermeable coveralls or similar full-body work clothing, gloves, and head coverings, as appropriate to protect areas of the body which may come in contact with liquid EtO or EtO-containing solutions.

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(b) Employers should ascertain that the protective garments are impermeable to EtO. Permeable clothing, including items made of rubber, and leather shoes should not be allowed to become contaminated with liquid EtO. If permeable clothing does become contaminated, it should be immediately removed, while the employer is under an emergency deluge shower. If leather footwear or other leather garments become wet from EtO they should be discarded and not be worn again, because leather absorbs EtO and holds it against the skin.

(c) Any protective clothing that has been damaged or is otherwise found to be defective should be repaired or replaced. Clean protective clothing should be provided to the employee as necessary to assure employee protection. Whenever impermeable clothing becomes wet with liquid EtO, it should be washed down with water before being removed by the employee. Employees are also required to wear splashproof safety goggles where there is any possibility of EtO contacting the eyes.

(6) **Miscellaneous precautions:**

(a) Store EtO in tightly closed containers in a cool, well-ventilated area and take all necessary precautions to avoid any explosion hazard.

(b) Nonsparking tools must be used to open and close metal containers. These containers must be effectively grounded and bonded.

(c) Do not incinerate EtO cartridges, tanks or other containers.

(d) Employers should advise employees of all areas and operations where exposure to EtO occurs.

(7) **Common operations:**

Common operations in which exposure to EtO is likely to occur include the following: (a) Manufacture of EtO, (b) surfactants, (c) ethanolamines, (d) glycol ethers, (e) specialty chemicals, and (f) use as a sterilant in the hospital, health product and spice industries.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07385, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), § 296-62-07385, filed 11/22/91, effective 12/24/91; 88-14-108 (Order 88-11), § 296-62-07385, filed 7/6/88; 87-24-051 (Order 87-24), § 296-62-07385, filed 11/30/87.]

WAC 296-62-07387 Appendix C--Medical surveillance guidelines for ethylene oxide (nonmandatory).

(1) **Route of entry:** Inhalation.

(2) **Toxicology:**

(a) Clinical evidence of adverse effects associated with the exposure to EtO is present in the form of increased incidence of cancer in laboratory animals (leukemia, stomach, brain), mutation in offspring in animals, and resorptions and spontaneous abortions in animals and human populations respectively. Findings in humans and experimental animals exposed to airborne concentrations of EtO also indicate damage to the genetic material (DNA). These include hemoglobin alkylation, unscheduled DNA synthesis, sister chromatid exchange chromosomal aberration, and functional sperm abnormalities.

(b) Ethylene oxide in liquid form can cause eye irritation and injury to the cornea, frostbite, severe irritation, and blistering of the skin upon prolonged or confined contact. Ingestion of EtO can cause gastric irritation and liver injury. Other effects from inhalation of EtO vapors include respiratory irritation and lung injury, headache, nausea, vomiting, diarrhea, dyspnea and cyanosis.

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(3) **Signs and symptoms of acute overexposure:**

(a) The early effects of acute overexposure to EtO are nausea and vomiting, headache, and irritation of the eyes and respiratory passages. The patient may notice a "peculiar taste" in the mouth. Delayed effects can include pulmonary edema, drowsiness, weakness, and incoordination. Studies suggest that blood cell changes, an increase in chromosomal aberrations, and spontaneous abortion may also be casually related to acute overexposure to EtO.

(b) Skin contact with liquid or gaseous EtO causes characteristic burns and possible even an allergic-type sensitization. The edema and erythema occurring from skin contact with EtO progress to vesiculation with a tendency to coalesce into blebs with desquamation. Healing occurs within three weeks, but there may be a residual brown pigmentation. A 40-80% solution is extremely dangerous, causing extensive blistering after only brief contact. Pure liquid EtO causes frostbite because of rapid evaporation. In contrast, the eye is relatively insensitive to EtO, but there may be some irritation of the cornea.

(c) Most reported acute effects of occupational exposure to EtO are due to contact with EtO in liquid phase. The liquid readily penetrates rubber and leather, and will produce blistering if clothing or footwear contaminated with EtO are not removed.

(4) **Surveillance and preventive considerations:**

(a) As noted above, exposure to EtO has been linked to an increased risk of cancer and reproductive effects including decreased male fertility, fetotoxicity, and spontaneous abortion. EtO workers are more likely to have chromosomal damage than similar groups not exposed to EtO. At the present, limited studies of chronic effects in humans resulting from exposure to EtO suggest a causal association with leukemia. Animal studies indicate leukemia and cancers at other sites (brain, stomach) as well. The physician should be aware of the findings of these studies in evaluating the health of employees exposed to EtO.

(b) Adequate screening tests to determine an employee's potential for developing serious chronic diseases, such as cancer, from exposure to EtO do not presently exist. Laboratory tests may, however, give evidence to suggest that an employee is potentially overexposed to EtO. It is important for the physician to become familiar with the operating conditions in which exposure to EtO is likely to occur. The physician also must become familiar with the signs and symptoms that indicate a worker is receiving otherwise unrecognized and unacceptable exposure to EtO. These elements are especially important in evaluating the medical and work histories and in conducting the physical exam. When an unacceptable exposure in an active employee is identified by the physician, measures taken by the employer to lower exposure should also lower the risk of serious long-term consequences.

(c) The employer is required to institute a medical surveillance program for all employees who are or will be exposed to EtO at or above the action level (0.5 ppm) for at least 30 days per year, without regard to respirator use. All examinations and procedures must be performed by or under the supervision of a licensed physician at a reasonable time and place for the employee and at no cost to the employee.

(d) Although broad latitude in prescribing specific tests to be included in the medical surveillance program is extended to the examining physician, WISHA requires inclusion of the following elements in the routine examination:

(i) Medical and work histories with special emphasis directed to symptoms related to the pulmonary, hematologic, neurologic, and reproductive systems and to the eyes and skin.

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(ii) Physical examination with particular emphasis given to the pulmonary, hematologic, neurologic, and reproductive systems and to the eyes and skin.

(iii) Complete blood count to include at least a white cell count (including differential cell count), red cell count, hematocrit, and hemoglobin.

(iv) Any laboratory or other test which the examining physician deems necessary by sound medical practice.

(e) If requested by the employee, the medical examinations shall include pregnancy testing or laboratory evaluation of fertility as deemed appropriate by the physician.

(f) In certain cases, to provide sound medical advice to the employer and the employee, the physician must evaluate situations not directly related to EtO. For example, employees with skin diseases may be unable to tolerate wearing protective clothing. In addition those with chronic respiratory diseases may not tolerate the wearing of negative pressure (air purifying) respirators. Additional tests and procedures that will help the physician determine which employees are medically unable to wear such respirators should include: An evaluation of cardiovascular function, a baseline chest x-ray to be repeated at five year intervals, and a pulmonary function test to be repeated every three years. The pulmonary function test should include measurement of the employee's forced vital capacity (FVC), forced expiratory volume at one second (FEV_1), as well as calculation of the ratios of FEV_1 to FVC, and measured FVC and measured FEV_1 to expected values corrected for variation due to age, sex, race, and height.

(g) The employer is required to make the prescribed tests available at least annually to employees who are or will be exposed at or above the action level, for 30 or more days per year; more often than specified if recommended by the examining physician; and upon the employee's termination of employment or reassignment to another work area. While little is known about the long-term consequences of high short-term exposures, it appears prudent to monitor such affected employees closely in light of existing health data. The employer shall provide physician recommended examinations to any employee exposed to EtO in emergency conditions. Likewise, the employer shall make available medical consultations including physician recommended exams to employees who believe they are suffering signs or symptoms of exposure to EtO.

(h) The employer is required to provide the physician with the following information: A copy of this standard and its appendices; a description of the affected employee's duties as they relate to the employee exposure level; and information from the employee's previous medical examinations which is not readily available to the examining physician. Making this information available to the physician will aid in the evaluation of the employee's health in relation to assigned duties and fitness to wear personal protective equipment, when required.

(i) The employer is required to obtain a written opinion from the examining physician containing the results of the medical examinations; the physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of his or her health from exposure to EtO; any recommended restrictions upon the employee's exposure to EtO, or upon the use of protective clothing or equipment such as respirators; and a statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions which require further explanation or treatment. This written opinion must not reveal specific findings or diagnoses unrelated to occupational exposure to EtO, and a copy of the opinion must be provided to the affected employee.

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(j) The purpose in requiring the examining physician to supply the employer with a written opinion is to provide the employer with a medical basis to aid in the determination of initial placement of employees and to assess the employee's ability to use protective clothing and equipment.

[Statutory Authority: Chapter 49.17 RCW. 88-14-108 (Order 88-11), § 296-62-07387, filed 7/6/88; 87-24-051 (Order 87-24), § 296-62-07387, filed 11/30/87.]

WAC 296-62-07389 Appendix D--Sampling and analytical methods for ethylene oxide (nonmandatory).

(1) A number of methods are available for monitoring employee exposures to EtO. Most of these involve the use of charcoal tubes and sampling pumps, followed by analysis of the samples by gas chromatograph. The essential differences between the charcoal tube methods include, among others, the use of different desorbing solvents, the use of different lots of charcoal, and the use of different equipment for analysis of the samples. Besides charcoal, methods using passive dosimeters, gas sampling bags, impingers, and detector tubes have been utilized for determination of EtO exposure. In addition, there are several commercially available portable gas analyzers and monitoring units. This appendix contains details for the method which has been tested at the OSHA Analytical Laboratory in Salt Lake City. Inclusion of this method in the appendix does not mean that this method is the only one which will be satisfactory. Copies of descriptions of other methods available are available in the rulemaking record, and may be obtained from the OSHA Docket Office. These include the Union Carbide, Dow Chemical, 3M, and DuPont methods, as well as NIOSH Method S-286. These methods are briefly described at the end of this appendix.

(2) Employers who note problems with sample breakthrough using the OSHA or other charcoal methods should try larger charcoal tubes. Tubes of larger capacity are available. In addition, lower flow rates and shorter sampling times should be beneficial in minimizing breakthrough problems. Whatever method the employer chooses, he/she must assure himself/herself of the method's accuracy and precision under the unique conditions present in his workplace.

(3) **Ethylene oxide:**

(a) Method No.: 30.

(b) Matrix: Air.

(i) Target concentration: 1.0 ppm (1.8 mg/m^3)

(ii) Procedure: Samples are collected on two charcoal tubes in series and desorbed with 1% CS2 in benzene. The samples are derivatized with HBr and treated with sodium carbonate. Analysis is done by gas chromatography with an electron capture detector.

(iii) Recommended air volume and sampling rate: 1 liter and 0.05 Lpm.

(iv) Detection limit of the overall procedure: 13.3 ppb (0.024 mg/m^3) (based on 1.0 liter air sample).

(v) Reliable quantitation limit: 52.2 ppb (0.094 mg/m^3) (based on 1.0 liter air sample).

(vi) Standard error of estimate: 6.59% (see backup section 4.6).

(vii) Special requirements: Samples must be analyzed within 15 days of sampling date.

(viii) Status of method: The sampling and analytical method has been subject to the established evaluation procedures of the Organic Method Evaluations Branch.

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(c) Date: August 1981.

(d) Chemist: Wayne D. Potter

(e) Organic Solvents Branch, OSHA Analytical Laboratory, Salt Lake City, Utah

(f) General discussion:

(i) Background.

(A) History of procedure.

(I) Ethylene oxide samples analyzed at the OSHA laboratory have normally been collected on activated charcoal and desorbed with carbon disulfide. The analysis is performed with a gas chromatograph equipped with a FID (flame ionization detector) as described in NIOSH Method S286 (Ref. (3)(j)(i)). This method is based on a PEL of 50 ppm and has a detection limit of about 1 ppm.

(II) Recent studies have prompted the need for a method to analyze and detect ethylene oxide at very low concentrations.

(III) Several attempts were made to form an ultraviolet (UV) sensitive derivative with ethylene oxide for analysis with HPLC. Among those tested that gave no detectable product were: p-anisidine, methylimidazole, aniline, and 2,3,6-trichlorobenzoic acid. Each was tested with catalysts such as triethylamine, aluminum chloride, methylene chloride and sulfuric acid but no detectable derivative was produced.

(IV) The next derivatization attempt was to react ethylene oxide with HBr to form 2-bromoethanol. This reaction was successful. An ECD (electron capture detector) gave a very good response for 2-bromoethanol due to the presence of bromine. The use of carbon disulfide as the desorbing solvent gave too large a response and masked the 2-bromoethanol. Several other solvents were tested for both their response on the ECD and their ability to desorb ethylene oxide from the charcoal. Among those tested were toluene, xylene, ethyl benzene, hexane, cyclohexane and benzene. Benzene was the only solvent tested that gave a suitable response on the ECD and a high desorption. It was found that the desorption efficiency was improved by using 1% CS2 with the benzene. The carbon disulfide did not significantly improve the recovery with the other solvents. SKC Lot 120 was used in all tests done with activated charcoal.

(B) Physical properties (Ref. (3)(j)(ii) - (iv)):

(I) Synonyms: Oxirane; dimethylene oxide; 1,2-epoxy-ethane; oxane; C_2H_4O; EtO;

(II) Molecular weight: 44.06;

(III) Boiling point: 10.7°C (51.3°);

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(IV) Melting point:--111°C;

(V) Description: Colorless, flammable gas;

(VI) Vapor pressure: 1095 mm. at 20°C;

(VII) Odor: Ether-like odor;

(VIII) Lower explosive limits: 3.0% (by volume);

(IX) Flash point (TOC): Below 0°F;

(X) Molecular structure: CH2--CH2;

(ii) Limit defining parameters:

(A) Detection limit of the analytical procedure. The detection limit of the analytical procedure is 12.0 picograms of ethylene oxide per injection. This is the amount of analyte which will give a peak whose height is five times the height of the baseline noise. (See backup data section (3)(i)(i).)

(B) Detection limit of the overall procedure.

(I) The detection limit of the overall procedure is 24.0 ng of ethylene oxide per sample.

(II) This is the amount of analyte spiked on the sampling device which allows recovery of an amount of analyte equivalent to the detection limit of the analytical procedure. (See backup data section (3)(i)(ii).)

(C) Reliable quantitation limit.

(I) The reliable quantitation limit is 94.0 nanograms of ethylene oxide per sample. This is the smallest amount of analyte which can be quantitated within the requirements of 75% recovery and 95% confidence limits. (See backup data section (3)(i)(ii).)

(II) It must be recognized that the reliable quantitation limit and detection limits reported in the method are based upon optimization of the instrument for the smallest possible amount of analyte. When the target concentration of an analyte is exceptionally higher than these limits, they may not be attainable at the routine operating parameters. In this case, the limits reported on analysis reports will be based on the operating parameters used during the analysis of the samples.

(D) Sensitivity.

(I) The sensitivity of the analytical procedure over a concentration range representing 0.5 to 2 times the target concentration based on the recommended air volume is 34105 area units per ug/mL. The sensitivity is determined by the slope of the calibration curve (see backup data section (3)(i)(iii)).

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(II) The sensitivity will vary somewhat with the particular instrument used in the analysis.

(E) Recovery. The recovery of analyte from the collection medium must be 75% or greater. The average recovery from spiked samples over the range of 0.5 to 2 times the target concentration is 88.0% (see backup section (3)(i)(iv)). At lower concentrations the recovery appears to be nonlinear.

(F) Precision (analytical method only). The pooled coefficient of variation obtained from replicate determination of analytical standards at 0.5X, 1X and 2X the target concentration is 0.036 (see backup data section (3)(i)(v)).

(G) Precision (overall procedure).

(I) The overall procedure must provide results at the target concentration that are 25% or better at the 95% confidence level. The precision at the 95% confidence level for the 15 day storage test is plus or minus 12.9% (see backup data section(3)(i)(vi)).

(II) This includes an additional plus or minus 5% for sampling error.

(iii) Advantages.

(A) The sampling procedure is convenient.

(B) The analytical procedure is very sensitive and reproducible.

(C) Reanalysis of samples is possible.

(D) Samples are stable for at least 15 days at room temperature.

(E) Interferences are reduced by the longer GC retention time of the new derivative.

(iv) Disadvantages.

(A) Two tubes in series must be used because of possible breakthrough and migration.

(B) The precision of the sampling rate may be limited by the reproducibility of the pressure drop across the tubes. The pumps are usually calibrated for one tube only.

(C) The use of benzene as the desorption solvent increases the hazards of analysis because of the potential carcinogenic effects of benzene.

(D) After repeated injections there can be a buildup of residue formed on the electron capture detector which decreases sensitivity.

(E) Recovery from the charcoal tubes appears to be nonlinear at low concentrations.

(g) Sampling procedure.

(i) Apparatus.

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(A) A calibrated personal sampling pump whose flow can be determined within plus or minus 5% of the recommended flow.

(B) SKC Lot 120 Charcoal tubes: Glass tube with both ends flame sealed, 7 cm long with a 6 mm O.D. and a 4-mm I.D., containing 2 sections of coconut shell charcoal separated by a 2-mm portion of urethane foam. The adsorbing section contains 100 mg of charcoal, the backup section 50 mg.

A 3-mm portion of urethane foam is placed between the outlet end of the tube and the backup section. A plug of silylated glass wool is placed in front of the adsorbing section.

(ii) Reagents. None required.

(iii) Sampling technique.

(A) Immediately before sampling, break the ends of the charcoal tubes. All tubes must be from the same lot.

(B) Connect two tubes in series to the sampling pump with a short section of flexible tubing. A minimum amount of tubing is used to connect the two sampling tubes together. The tube closer to the pump is used as a backup. This tube should be identified as the backup tube.

(C) The tubes should be placed in a vertical position during sampling to minimize channeling.

(D) Air being sampled should not pass through any hose or tubing before entering the charcoal tubes.

(E) Seal the charcoal tubes with plastic caps immediately after sampling. Also, seal each sample with OSHA seals lengthwise.

(F) With each batch of samples, submit at least one blank tube from the same lot used for samples. This tube should be subjected to exactly the same handling as the samples (break, seal, transport) except that no air is drawn through it.

(G) Transport the samples (and corresponding paperwork) to the lab for analysis.

(H) If bulk samples are submitted for analysis, they should be transported in glass containers with Teflon-lined caps. These samples must be mailed separately from the container used for the charcoal tubes.

(iv) Breakthrough.

The breakthrough (5% breakthrough) volume for a 3.0 mg/m^3 ethylene oxide sample stream at approximately 85% relative humidity, 22°C and 633 mm is 2.6 liters sampled at 0.05 liters per minute. This is equivalent to 7.8 µg of ethylene oxide. Upon saturation of the tube it appeared that the water may be displacing ethylene oxide during sampling.

(v) Desorption efficiency.

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(A) The desorption efficiency, from liquid injection onto charcoal tubes, averaged 88.0% from 0.5 to 2.0 x the target concentration for a 1.0 liter air sample. At lower ranges it appears that the desorption efficiency is nonlinear (see backup data section (3)(i)(ii)).

(B) The desorption efficiency may vary from one laboratory to another and also from one lot of charcoal to another. Thus, it is necessary to determine the desorption efficiency for a particular lot of charcoal.

(vi) Recommended air volume and sampling rate.

(A) The recommended air volume is 1.0 liter.

(B) The recommended maximum sampling rate is 0.05 Lpm.

(vii) Interferences.

(A) Ethylene glycol and Freon 12 at target concentration levels did not interfere with the collection of ethylene oxide.

(B) Suspected interferences should be listed on the sample data sheets.

(C) The relative humidity may affect the sampling procedure.

(viii) Safety precautions.

(A) Attach the sampling equipment to the employee so that it does not interfere with work performance.

(B) Wear safety glasses when breaking the ends of the sampling tubes.

(C) If possible, place the sampling tubes in a holder so the sharp end is not exposed while sampling.

(h) Analytical method.

(i) Apparatus.

(A) Gas chromatograph equipped with a linearized electron capture detector.

(B) GC column capable of separating the derivative of ethylene oxide (2-bromoethanol) from any interferences and the 1% CS2 in benzene solvent. The column used for validation studies was: 10 ft x 1/8 inch stainless steel 20% SP-2100, .1% Carbowax 1500 on 100/120 Supelcoport.

(C) An electronic integrator or some other suitable method of measuring peak areas.

(D) Two milliliter vials with Teflon-lined caps.

(E) Gas tight syringe--500 µL or other convenient sizes for preparing standards.

(F) Microliter syringes--10 µL or other convenient sizes for diluting standards and 1 µL for sample injections.

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(G) Pipets for dispensing the 1% CS2 in benzene solvent. The Glenco 1 mL dispenser is adequate and convenient.

(H) Volumetric flasks--5 mL and other convenient sizes for preparing standards.

(I) Disposable Pasteur pipets.

(ii) Reagents.

(A) Benzene, reagent grade.

(B) Carbon disulfide, reagent grade.

(C) Ethylene oxide, 99.7% pure.

(D) Hydrobromic acid, 48% reagent grade.

(E) Sodium carbonate, anhydrous, reagent grade.

(F) Desorbing reagent, 99% Benzene/1% CS2.

(iii) Sample preparation.

(A) The front and back sections of each sample are transferred to separate 2-mL vials.

(B) Each sample is desorbed with 1.0 mL of desorbing reagent.

(C) The vials are sealed immediately and allowed to desorb for one hour with occasional shaking.

(D) Desorbing reagent is drawn off the charcoal with a disposable pipet and put into clean 2-mL vials.

(E) One drop of HBr is added to each vial. Vials are resealed and HBr is mixed well with the desorbing reagent.

(F) About 0.15 gram of sodium carbonate is carefully added to each vial. Vials are again resealed and mixed well.

(iv) Standard preparation.

(A) Standards are prepared by injecting the pure ethylene oxide gas into the desorbing reagent.

(B) A range of standards are prepared to make a calibration curve. A concentration of 1.0 µL of ethylene oxide gas per 1 mL desorbing reagent is equivalent to 1.0 ppm air concentration (all gas volumes at 25°C and 760 mm) for the recommended 1 liter air sample. This amount is uncorrected for desorption efficiency (see backup data section (3)(i)(ii), for desorption efficiency corrections).

(C) One drop of HBr per mL of standard is added and mixed well.

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(D) About 0.15 grams of sodium carbonate is carefully added for each drop of HBr (a small reaction will occur).

(v) Analysis.

(A) GC conditions.

Nitrogen flow rate--10mL/min.

Injector temperature--250°C

Detector temperature--300°C

Column temperature--100°C

Injection size--0.8 µL

Elution time--3.9 minutes

(B) Peak areas are measured by an integrator or other suitable means.

(C) The integrator results are in area units and a calibration curve is set up with concentration vs. area units.

(vi) Interferences.

(A) Any compound having the same retention time of 2-bromoethanol is a potential interference. Possible interferences should be listed on the sample data sheets.

(B) GC parameters may be changed to circumvent interferences.

(C) There are usually trace contaminants in benzene.

These contaminants, however, posed no problem of interference.

(D) Retention time date on a single column is not considered proof of chemical identity. Samples over the 1.0 ppm target level should be confirmed by GC/Mass Spec or other suitable means.

(vii) Calculations.

(A) The concentration in µg/mL for a sample is determined by comparing the area of a particular sample to the calibration curve, which has been prepared from analytical standards.

(B) The amount of analyte in each sample is corrected for desorption efficiency by use of a desorption curve.

(C) Analytical results, A, from the two tubes that compose a particular air sample are added together.

WAC 296-62-07389 (Cont.)

(D) The concentration for a sample is calculated by the following equation:

$$\text{EtO, mg/m}^3 = \frac{A \times B}{C}$$

where:

A = µg/mL

B = desorption volume in milliliters

C = air volume in liters.

(E) To convert mg/m^3 to parts per million (ppm) the following relationship is used:

$$\text{EtO, ppm} = \frac{\text{mg/m}^3 \times 24.45}{44.05}$$

where:

mg/m^3 = results from 3.7.4

24.45 = molar volume at 25°C and 760mm Hg

44.05 = molecular weight of EtO.

(viii) Safety precaution.

(A) Ethylene oxide and benzene are potential carcinogens and care must be exercised when working with these compounds.

(B) All work done with the solvents (preparation of standards, desorption of samples, etc.) should be done in a hood.

(C) Avoid any skin contact with all of the solvents.

(D) Wear safety glasses at all times.

(E) Avoid skin contact with HBr because it is highly toxic and a strong irritant to eyes and skin.

(i) Backup data.

(i) Detection limit data.

The detection limit was determined by injecting 0.8 µL of a 0.015 µg/mL standard of ethylene oxide into 1% CS2 in benzene. The detection limit of the analytical procedure is taken to be 1.20 x 10-5 µg per injection. This is equivalent to 8.3 ppb (0.015 mg/m^3) for the recommended air volume.

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(ii) Desorption efficiency. Ethylene oxide was spiked into charcoal tubes and the following recovery data was obtained:

Amount Spiked (µg)	Amount Recovered (µg)	Percent Recovery
4.5	4.32	96.0
3.0	2.61	87.0
2.25	2.025	90.0
1.5	1.365	91.0
1.6	1.38	92.0
.75	.6525	87.0
.375	.315	84.0
.375	.312	83.2
.1875	.151	80.5
.094	.070	74.5

Note: At lower amounts the recovery appears to be nonlinear.

(iii) Sensitivity data. The following data was used to determine the calibration curve:

Injection	0.5 x .75 µg/mL	1 x 1.5 µg/mL	2 x 3.0 µg/mL
1	30904	59567	111778
2	30987	62914	106016
3	32555	58578	106122
4	32242	57173	109716
X	31672	59558	108408

Slope = 34.105.

(iv) Recovery. The recovery was determined by spiking ethylene oxide onto lot 120 charcoal tubes and desorbing with 1% CS2 in Benzene. Recoveries were done at 0.5, 1.0, and 2.0 X the target concentration (1 ppm) for the recommended air volume.

Percent Recovery

Sample	0.5x	1.0x	2.0x
1	88.7	95.0	91.7
2	83.8	95.0	87.3
3	84.2	91.0	86.0
4	88.0	91.0	83.0
5	88.0	86.0	85.0
X	86.5	90.5	87.0

Weighted average = 88.2

(v) Precision of the analytical procedure. The following data was used to determine the precision of the analytical method:

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Concentration	0.5 x .75 µg/ml	1 x 1.5 µg/mL	2 x 3.0 µg/mL
Injection	.7421	1.4899	3.1184
	.7441	1.5826	3.0447
	.7831	1.4628	2.9149
	.7753	1.4244	2.9185
Average	.7612	1.4899	2.9991
Standard Deviation	.0211	.0674	.0998
CV	.0277	.0452	.0333

$$CV = \frac{3(.0277)^2 + 3(.0452)^2 + 3(.0333)^2}{3 + 3 + 3}$$

CV + 0.036

(vi) Storage data. Samples were generated at 1.5 mg/m^3 ethylene oxide at 85% relative humidity, 22°C and 633 mm. All samples were taken for 20 minutes at 0.05 Lpm. Six samples were analyzed as soon as possible and fifteen samples were stored at refrigerated temperature (5°C) and fifteen samples were stored at ambient temperature (23°C). These stored samples were analyzed over a period of nineteen days.

Percent Recovery

Day Analyzed	Refrigerated	Ambient
1	87.0	87.0
1	93.0	93.0
1	94.0	94.0
1	92.0	92.0
4	92.0	91.0
4	93.0	88.0
4	91.0	89.0
6	92.0	--
6	92.0	--
8	--	92.0
8	--	86.0
10	91.7	--
10	95.5	--
10	95.7	--
11	--	90.0
11	--	82.0
13	78.0	--
13	81.4	--
13	82.4	--
14	--	78.5
14	--	72.1
18	66.0	--
18	68.0	--
19	--	64.0
19	--	77.0

WAC 296-62-07389 (Cont.)

(vii) Breakthrough data.

(A) Breakthrough studies were done at 2 ppm (3.6 mg/m^3) at approximately 85% relative humidity at 22°C (ambient temperature). Two charcoal tubes were used in series. The backup tube was changed every 10 minutes and analyzed for breakthrough. The flow rate was 0.050 Lpm.

Tube No.	Time (minutes)	Percent Breakthrough
1	10	(*)
2	20	(*)
3	30	(*)
4	40	1.23
5	50	3.46
6	60	18.71
7	70	39.2
8	80	53.3
9	90	72.0
10	100	96.0
11	110	113.0
12	120	133.9

*None.

(B) The 5% breakthrough volume was reached when 2.6 liters of test atmosphere were drawn through the charcoal tubes.

(j) References.

(i) "NIOSH Manual of Analytical Methods," 2nd ed. NIOSH: Cincinnati, 1977; Method S 286.

(ii) "IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man." International Agency for Research on Cancer: Lyon, 1976; Vol. II, p. 157.

(iii) Sax., N.I. "Dangerous Properties of Industrial Materials," 4th ed.; Van Nostrand Reinhold Company, New York, 1975; p. 741.

(iv) "The Condensed Chemical Dictionary," 9th ed.; Hawley, G.G., ed.; Van Nostrand Reinhold Company, New York, 1977; p. 361.

(4) **Summary of other sampling procedures.** OSHA believes that several other types of monitoring equipment and techniques exist for monitoring time-weighted averages. Considerable research and method development is currently being performed, which will lead to improvements and a wider variety of monitoring techniques. A combination of monitoring procedures can be used. There probably is no one best method for monitoring personal exposure to ethylene oxide in all cases. There are advantages, disadvantages, and limitations to each method. The method of choice will depend on the need and requirements. Some commonly used methods include the use of charcoal tubes, passive dosimeters, Tedler gas sampling bags, detector tubes, photoionization detection units, infrared detection units and gas chromatographs. A number of these methods are described below.

(a) Charcoal tube sampling procedures.

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(i) Qazi-Ketcham method (Ex-11-133)--This method consists of collecting EtO on Columbia JXC activated carbon, desorbing the EtO with carbon disulfide and analyzing by gas chromatography with flame ionization detection. Union Carbide has recently updated and revalidated this monitoring procedure. This method is capable of determining both eight-hour time-weighted average exposures and short-term exposures. The method was validated to 0.5 ppm. Like other charcoal collecting procedures, the method requires considerable analytical expertise.

(ii) ASTM-proposed method--The Ethylene Oxide Industry Council (EOIC) has contracted with Clayton Environmental Consultants, Inc. to conduct a collaborative study for the proposed method. The ASTM-Proposed method is similar to the method published by Qazi and Ketcham in the November 1977 American Industrial Hygiene Association Journal, and to the method of Pilney and Coyne, presented at the 1979 American Industrial Hygiene Conference. After the air to be sampled is drawn through an activated charcoal tube, the ethylene oxide is desorbed from the tube using carbon disulfide and is quantitated by gas chromatography utilizing a flame ionization detector. The ASTM-proposed method specifies a large two-section charcoal tube, shipment in dry ice, storage at less than -5°C, and analysis within three weeks to prevent migration and sample loss. Two types of charcoal tubes are being tested--Pittsburgh Coconut-Based (PCB) and columbia JXC charcoal. This collaborative study will give an indication of the inter- and intralaboratory precision and accuracy of the ASTM/proposed method. Several laboratories have considerable expertise using the Qazi-Ketcham and Dow methods.

(b) Passive monitors--Ethylene oxide diffuses into the monitor and is collected in the sampling media. The DuPont Pro-Tek badge collects EtO in an absorbing solution, which is analyzed colorimetrically to determine the amount of EtO present. The 3M 350 badge collects the EtO on chemically treated charcoal. Other passive monitors are currently being developed and tested. Both 3M and DuPont have submitted data indicating their dosimeters meet the precision and accuracy requirements of the proposed ethylene oxide standard. Both presented laboratory validation data to 0.2 ppm (Exs. 11-65, 4-20, 108, 109, 130).

(c) Tedlar gas sampling bags-samples are collected by drawing a known volume of air into a Tedlar gas sampling bag. The ethylene oxide concentration is often determined on-site using a portable gas chromatograph or portable infrared spectometer.

(d) Detector tubes--A known volume of air is drawn through a detector tube using a small hand pump. The concentration of EtO is related to the length of stain developed in the tube. Detector tubes are economical, easy to use, and give an immediate readout. Unfortunately, partly because they are nonspecific, their accuracy is often questionable. Since the sample is taken over a short period of time, they may be useful for determining the source of leaks.

(e) Direct reading instruments:

(i) There are numerous types of direct reading instruments, each having its own strengths and weaknesses (Exs. 135B, 135C, 107, 11-78, 11-153). Many are relatively new, offering greater sensitivity and specificity. Popular ethylene oxide direct reading instruments include infrared detection units, photoionization detection units, and gas chromatographs.

(ii) Portable infrared analyzers provide an immediate, continuous indication of a concentration value; making them particularly useful for locating high concentration pockets, in leak detection and in ambient air monitoring. In infrared detection units, the amount of infrared light absorbed by the gas being analyzed at selected infrared

WAC 296-62-07389 (Cont.)

wavelengths is related to the concentration of a particular component. Various models have either fixed or variable infrared filters, differing cell pathlengths, and microcomputer controls for greater sensitivity, automation, and interference elimination.

(iii) A fairly recent detection system is photoionization detection. The molecules are ionized by high energy ultraviolet light. The resulting current is measured. Since different substances have different ionization potentials, other organic compounds may be ionized. The lower the lamp energy, the better the selectivity. As a continuous monitor, photoionization detection can be useful for locating high concentration pockets, in leak detection, and continuous ambient air monitoring. Both portable and stationary gas chromatographs are available with various types of detectors, including photoionization detectors. A gas chromatograph with a photoionization detector retains the photoionization sensitivity, but minimizes or eliminates interferences. For several GC/PID units, the sensitivity is in the 0.1-0.2 ppm EtO range. The GC/PID with microprocessors can sample up to 20 sample points sequentially, calculate and record data, and activate alarms or ventilation systems. Many are quite flexible and can be configured to meet the specific analysis needs for the workplace.

(iv) DuPont presented their laboratory validation data of the accuracy of the Qazi-Ketcham charcoal tube, the PCB charcoal tube, Miran 103 IR analyzer, 3M #3550 monitor and the DuPont C-70 badge. Quoting Elbert V. Kring:

(v) We also believe that OSHA's proposed accuracy in this standard is appropriate. At plus or minus 25 percent at one part per million, and plus or minus 35 percent below that. And, our data indicates there's only one monitoring method, right now, that we've tested thoroughly, that meets that accuracy requirements. That is the DuPont Pro-Tek badge* * *. We also believe that this kind of data should be confirmed by another independent laboratory, using the same type dynamic chamber testing (Tr. 1470).

Additional data by an independent laboratory following their exact protocol was not submitted. However, information was submitted on comparisons and precision and accuracy of those monitoring procedures which indicate far better precision and accuracy of those monitoring procedures than that obtained by DuPont (Ex. 4-20, 130, 11-68, 11-133, 130, 135A).

(vi) The accuracy of any method depends to a large degree upon the skills and experience of those who not only collect the samples but also those who analyze the samples. Even for methods that are collaboratively tested, some laboratories are closer to the true values than others. Some laboratories may meet the precision and accuracy requirements of the method; others may consistently far exceed them for the same method.

[Statutory Authority: Chapter 49.17 RCW. 88-14-108 (Order 88-11), § 296-62-07389, filed 7/6/88; 87-24-051 (Order 87-24), § 296-62-07389, filed 11/30/87.]

WAC 296-62-074 Cadmium.

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-074, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07401 Scope. This standard applies to all occupational exposures to cadmium and cadmium compounds, in all forms, and in all industries covered by the Washington Industrial Safety and Health Act, except the construction-related industries, which are covered under WAC 296-155-174.

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07401, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07403 Definitions.

(1) **"Action level"** (AL) is defined as an airborne concentration of cadmium of 2.5 micrograms per cubic meter of air (2.5 µg/m^3), calculated as an 8-hour time-weighted average (TWA).

WAC 296-62-07403 (Cont.)

(2) **"Authorized person"** means any person authorized by the employer and required by work duties to be present in regulated areas or any person authorized by the WISH Act or regulations issued under it to be in regulated areas.

(3) **"Director"** means the director of the department of labor and industries, or authorized representatives.

(4) **"Employee exposure"** and similar language referring to the air cadmium level to which an employee is exposed means the exposure to airborne cadmium that would occur if the employee were not using respiratory protective equipment.

(5) **"Final medical determination"** is the written medical opinion of the employee's health status by the examining physician under WAC 296-62-07423(3) through (12) or, if multiple physician review under WAC 296-62-07423(13) or the alternative physician determination under WAC 296-62-07423(14) is invoked, it is the final, written medical finding, recommendation or determination that emerges from that process.

(6) **High-efficiency particulate air (HEPA) filter** means a filter capable of trapping and retaining at least 99.97 percent of mono-dispersed particles of 0.3 micrometers in diameter.

(7) **Regulated area** means an area demarcated by the employer where an employee's exposure to airborne concentrations of cadmium exceeds, or can reasonably be expected to exceed the permissible exposure limit (PEL).

[Statutory Authority: Chapter 49.17 RCW. 93-21-075 (Order 93-06), § 296-62-07403, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07403, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07405 Permissible exposure limit (PEL). The employer shall assure that no employee is exposed to an airborne concentration of cadmium in excess of five micrograms per cubic meter of air (5 $\mu g/m^3$), calculated as an 8-hour time-weighted average exposure (TWA).

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07405, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07407 Exposure monitoring.

(1) **General.**

(a) Each employer who has a workplace or work operation covered by this section shall determine if any employee may be exposed to cadmium at or above the action level.

(b) Determinations of employee exposure shall be made from breathing zone air samples that reflect the monitored employee's regular, daily 8-hour TWA exposure to cadmium.

(c) 8-hour TWA exposures shall be determined for each employee on the basis of one or more personal breathing zone air samples reflecting full shift exposure on each shift, for each job classification, in each work area. Where several employees perform the same job tasks, in the same job classification, on the same shift, in the same work area, and the length, duration, and level of cadmium exposures are similar, an employer may sample a representative fraction of the employees instead of all employees in order to meet this requirement. In representative sampling, the employer shall sample the employee(s) expected to have the highest cadmium exposures.

(2) **Specific.**

(a) Initial monitoring. Except as provided for in (b) and (c) of this subsection, the employer shall monitor employee exposures and shall base initial determinations on the monitoring results.

WAC 296-62-07407 (Cont.)

(b) Where the employer has monitored after September 14, 1991, under conditions that in all important aspects closely resemble those currently prevailing and where that monitoring satisfies all other requirements of this section, including the accuracy and confidence levels of subsection (6) of this section, the employer may rely on such earlier monitoring results to satisfy the requirements of WAC 296-62-07427 (2)(a).

(c) Where the employer has objective data, as defined in WAC 296-62-07427(2), demonstrating that employee exposure to cadmium will not exceed the action level under the expected conditions of processing, use, or handling, the employer may rely upon such data instead of implementing initial monitoring.

(3) **Monitoring frequency (periodic monitoring).**

(a) If the initial monitoring or periodic monitoring reveals employee exposures to be at or above the action level, the employer shall monitor at a frequency and pattern needed to represent the levels of exposure of employees and where exposures are above the PEL to assure the adequacy of respiratory selection and the effectiveness of engineering and work-practice controls. However, such exposure monitoring shall be performed at least every six months. The employer, at a minimum, shall continue these semiannual measurements unless and until the conditions set out in (b) of this subsection are met.

(b) If the initial monitoring or the periodic monitoring indicates that employee exposures are below the action level and that result is confirmed by the results of another monitoring taken at least seven days later, the employer may discontinue the monitoring for those employees whose exposures are represented by such monitoring.

(4) **Additional monitoring.** The employer also shall institute the exposure monitoring required under (2)(a) and (3) of this section whenever there has been a change in the raw materials, equipment, personnel, work-practices, or finished products that may result in additional employees being exposed to cadmium at or above the action level or in employees already exposed to cadmium at or above the action level being exposed above the PEL, or whenever the employer has any reason to suspect that any other change might result in such further exposure.

(5) **Employee notification of monitoring results.**

(a) Within fifteen working days after the receipt of the results of any monitoring performed under this section, the employer shall notify each affected employee individually in writing of the results. In addition, within the same time period the employer shall post the results of the exposure monitoring in an appropriate location that is accessible to all affected employees.

(b) Wherever monitoring results indicate that employee exposure exceeds the PEL, the employer shall include in the written notice a statement that the PEL has been exceeded and a description of the corrective action being taken by the employer to reduce employee exposure to or below the PEL.

(6) **Accuracy of measurement.** The employer shall use a method of monitoring and analysis that has an accuracy of not less than plus or minus twenty-five percent, with a confidence level of ninety-five percent, for airborne concentrations of cadmium at or above the action level, the permissible exposure limit (PEL), and the separate engineering control air limit (SECAL).

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07407, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07409 Regulated areas.

(1) **Establishment.** The employer shall establish a regulated area wherever an employee's exposure to airborne concentrations of cadmium is, or can reasonably be expected to be in excess of the permissible exposure limit (PEL).

WAC 296-62-07409 (Cont.)

(2) **Demarcation.** Regulated areas shall be demarcated from the rest of the workplace in any manner that adequately establishes and alerts employees of the boundaries of the regulated area.

(3) **Access.** Access to regulated areas shall be limited to authorized persons.

(4) **Provision of respirators.** Each person entering a regulated area shall be supplied with and required to use a respirator, selected in accordance with WAC 296-62-07413(2).

(5) **Prohibited activities.** The employer shall assure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas, carry the products associated with these activities into regulated areas, or store such products in those areas.

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07409, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07411 Methods of compliance.

(1) **Compliance hierarchy.**

(a) Except as specified in (b), (c), and (d) of this subsection, the employer shall implement engineering and work-practice controls to reduce and maintain employee exposure to cadmium at or below the PEL, except to the extent that the employer can demonstrate that such controls are not feasible.

(b) Except as specified in (c) and (d) of this subsection, in industries where a separate engineering control air limit (SECAL) has been specified for particular processes (Table 1 of this subsection), the employer shall implement engineering and work-practice controls to reduce and maintain employee exposure at or below the SECAL, except to the extent that the employer can demonstrate that such controls are not feasible.

Table 1.--Separate Engineering Control Airborne Limits (SECALs) for Processes in Selected Industries (SECALs)

Process	SECAL	(µg/m^3)
Nickel Cadmium battery	Plate making, plate preparation All other processes	50 15
Zinc/Cadmium refining	Cadmium refining, casting, melting. oxide production, sinter plant	50
Pigment manufacture	Calcine, crushing, milling, blending All other processes	50 15
Stabilizers	Cadmium oxice charging, crushing, drying, blending	50
Lead smelting+	Sinter plant, blast furnace, baghouse, yard area	50
Plating*	Mechanical plating	15

* Processes in these industries that are not specified in this table must achieve the PEL using engineering controls and work-practices as required in (a) of this subsection.

(c) The requirement to implement engineering and work-practice controls to achieve the PEL or, where applicable, the SECAL does not apply where the employer demonstrates the following:

(i) The employee is only intermittently exposed; and

(ii) The employee is not exposed above the PEL on thirty or more days per year (twelve consecutive months).

WAC 296-62-07411 (Cont.)

(d) Wherever engineering and work-practice controls are required and are not sufficient to reduce employee exposure to or below the PEL or, where applicable, the SECAL, the employer nonetheless shall implement such controls to reduce exposures to the lowest levels achievable. The employer shall supplement such controls with respiratory protection that complies with the requirements of WAC 296-62-07413 and the PEL.

(e) The employer shall not use employee rotation as a method of compliance.

(2) **Compliance program.**

(a) Where the PEL is exceeded, the employer shall establish and implement a written compliance program to reduce employee exposure to or below the PEL by means of engineering and work-practice controls, as required by subsection (1) of this section. To the extent that engineering and work-practice controls cannot reduce exposures to or below the PEL, the employer shall include in the written compliance program the use of appropriate respiratory protection to achieve compliance with the PEL.

(b) Written compliance programs shall include at least the following:

(i) A description of each operation in which cadmium is emitted; e.g., machinery used, material processed, controls in place, crew size, employee job responsibilities, operating procedures, and maintenance practices;

(ii) A description of the specific means that will be employed to achieve compliance, including engineering plans and studies used to determine methods selected for controlling exposure to cadmium, as well as, where necessary, the use of appropriate respiratory protection to achieve the PEL;

(iii) A report of the technology considered in meeting the PEL;

(iv) Air monitoring data that document the sources of cadmium emissions;

(v) A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment, construction contracts, etc.;

(vi) A work-practice program that includes items required under WAC 296-62-07415, 296-62-07417, and 296-62-07419;

(vii) A written plan for emergency situations, as specified in WAC 296-62-07415; and

(viii) Other relevant information.

(c) The written compliance programs shall be reviewed and updated at least annually, or more often if necessary, to reflect significant changes in the employer's compliance status.

(d) Written compliance programs shall be provided upon request for examination and copying to affected employees, designated employee representatives, and the director.

WAC 296-62-07411 (Cont.)

(3) **Mechanical ventilation.**

(a) When ventilation is used to control exposure, measurements that demonstrate the effectiveness of the system in controlling exposure, such as capture velocity, duct velocity, or static pressure shall be made as necessary to maintain its effectiveness.

(b) Measurements of the system's effectiveness in controlling exposure shall be made as necessary within five working days of any change in production, process, or control that might result in a significant increase in employee exposure to cadmium.

(c) Recirculation of air. If air from exhaust ventilation is recirculated into the workplace, the system shall have a high efficiency filter and be monitored to assure effectiveness.

(d) Procedures shall be developed and implemented to minimize employee exposure to cadmium when maintenance of ventilation systems and changing of filters is being conducted.

[Statutory Authority: Chapter 49.17 RCW. 93-21-075 (Order 93-06), § 296-62-07411, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07411, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07413 Respirator protection.

(1) **General.** For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(a) Periods necessary to install or implement feasible engineering and work-practice controls when employee exposure levels exceed the PEL;

(b) Maintenance and repair activities, and brief or intermittent operations, where employee exposures exceed the PEL and engineering and work-practice controls are not feasible or are not required;

(c) Activities in regulated areas as specified in WAC 296-62-07409;

(d) Work operations for which the employer has implemented all feasible engineering and work-practice controls and such controls are not sufficient to reduce employee exposures to or below the PEL;

(e) Work operations for which an employee who is exposed to cadmium at or above the action level, and the employee requests a respirator;

(f) Work operations for which an employee is exposed above the PEL and engineering controls are not required by WAC 296-62-07411(1)(b); and

(g) Emergencies.

(2) **Respirator program.**

(a) The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(b) No employees must use a respirator if, based on their recent medical examination, the examining physician determines that they will be unable to continue to function normally while using a respirator. If the physician determines that the employee must be limited in, or removed from, their current job because of their inability to use a respirator, the limitation or removal must be in accordance with WAC 296-62-07423(11) and (12).

WAC 296-62-07413 (Cont.)

(c) If an employee has breathing difficulty during fit testing or respirator use, the employer must provide the employee with a medical examination as required by WAC 296-62-07423(6)(b) to determine if the employee can use a respirator while performing the required duties.

(3) Respirator selection.

(a) The employer must select the appropriate respirator from Table 2 of this section.

Table 2.--Respiratory Protection for Cadmium

Airborne concentration	Required respirator type[b]
10 x or less	A half mask, air-purifying respirator equipped with a HEPA[c] filter.[d]
25 x or less	A powered air-purifying respirator ("PAPR") with a loose-fitting hood or helmet equipped with a HEPA filter, or a supplied-air respirator with a loose-fitting hood or helmet facepiece operated in the continuous flow mode.
50 x or less	A full facepiece air-purifying respirator equipped with a HEPA filter, or a powered air-purifying respirator with a tight-fitting half mask equipped with a HEPA filter, or a supplied air respirator with a tight-fitting half mask operated in the continuous flow mode.
250 x or less	A powered air-purifying respirator with a tight-fitting full facepiece equipped with a HEPA filter, or a supplied-air respirator with a tight-fitting full facepiece operated in the continuous flow mode.
1000 x or less	A supplied-air respirator with half mask or full facepiece operated in the pressure demand or other positive pressure mode.
>1000 x or unknown concentrations	A self-contained breathing apparatus with a full facepiece operated in the pressure demand or other positive pressure mode, or a supplied-air respirator with a full facepiece operated in the pressure demand or other positive pressure mode and equipped with an auxiliary escape type self-contained breathing apparatus operated in the pressure demand mode.
Fire fighting	A self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

[a] Concentrations expressed as multiple of the PEL.
[b] Respirators assigned for higher environmental concentrations may be used at lower exposure levels. Quantitative fit testing is required for all tight-fitting air purifying respirators where airborne concentration of cadmium exceeds 10 times the TWA PEL (10x5 $\mu g/m^3$ = 50 $\mu g/m^3$). A full facepiece respirator is required when eye irritation is experienced.
[c] HEPA means High Efficiency Particulate Air.
[d] Fit testing, qualitative or quantitative, is required.

SOURCE: Respiratory Decision Logic, NIOSH, 1987.

(b) The employer must provide an employee with a powered, air-purifying respirator (PAPR) instead of a negative-pressure respirator when an employee who is entitled to a respirator chooses to use this type of respirator, and such a respirator provides adequate protection to the employee.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § § 296-62-07413, filed 05/04/99, effective 09/01/99. Statutory Authority: Chapter 49.17 RCW. 93-21-075 (Order 93-06), § 296-62-07413, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07413, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07415 Emergency situations. The employer shall develop and implement a written plan for dealing with emergency situations involving substantial releases of airborne cadmium. The plan shall include provisions for the use of appropriate respirators and personal protective equipment. In addition, employees not essential to correcting the emergency situation shall be restricted from the area and normal operations halted in that area until the emergency is abated.
[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07415, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07417 Protective work clothing and equipment.

(1) **Provision and use.** If an employee is exposed to airborne cadmium above the PEL or where skin or eye irritation is associated with cadmium exposure at any level, the employer shall provide at no cost to the employee, and assure that the employee uses, appropriate protective work clothing and equipment that prevents contamination of the employee and the employee's garments. Protective work clothing and equipment includes, but is not limited to:

(a) Coveralls or similar full-body work clothing;

(b) Gloves, head coverings, and boots or foot coverings; and

(c) Face shields, vented goggles, or other appropriate protective equipment that complies with WAC 296-800-160.

(2) **Removal and storage.**

(a) The employer shall assure that employees remove all protective clothing and equipment contaminated with cadmium at the completion of the work shift and do so only in change rooms provided in accordance with WAC 296-62-07419(1).

(b) The employer shall assure that no employee takes cadmium-contaminated protective clothing or equipment from the workplace, except for employees authorized to do so for purposes of laundering, cleaning, maintaining, or disposing of cadmium contaminated protective clothing and equipment at an appropriate location or facility away from the workplace.

(c) The employer shall assure that contaminated protective clothing and equipment, when removed for laundering, cleaning, maintenance, or disposal, is placed and stored in sealed, impermeable bags or other closed, impermeable containers that are designed to prevent dispersion of cadmium dust.

(d) The employer shall assure that bags or containers of contaminated protective clothing and equipment that are to be taken out of the change rooms or the workplace for laundering, cleaning, maintenance, or disposal shall bear labels in accordance with WAC 296-62-07425(3).

(3) **Cleaning, replacement, and disposal.**

(a) The employer shall provide the protective clothing and equipment required by subsection (1) of this section in a clean and dry condition as often as necessary to maintain its effectiveness, but in any event at least weekly. The employer is responsible for cleaning and laundering the protective clothing and equipment required by this paragraph to maintain its effectiveness and is also responsible for disposing of such clothing and equipment.

(b) The employer also is responsible for repairing or replacing required protective clothing and equipment as needed to maintain its effectiveness. When rips or tears are detected while an employee is working they shall be immediately mended, or the worksuit shall be immediately replaced.

WAC 296-62-07417 (Cont.)

(c) The employer shall prohibit the removal of cadmium from protective clothing and equipment by blowing, shaking, or any other means that disperses cadmium into the air.

(d) The employer shall assure that any laundering of contaminated clothing or cleaning of contaminated equipment in the workplace is done in a manner that prevents the release of airborne cadmium in excess of the permissible exposure limit prescribed in WAC 296-62-07405.

(e) The employer shall inform any person who launders or cleans protective clothing or equipment contaminated with cadmium of the potentially harmful effects of exposure to cadmium and that the clothing and equipment should be laundered or cleaned in a manner to effectively prevent the release of airborne cadmium in excess of the PEL.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07417, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 94-20-057 (Order 94-16), § 296-62-07417, filed 9/30/94, effective 11/20/94; 93-21-075 (Order 93-06), § 296-62-07417, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07417, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07419 Hygiene areas and practices.

(1) **General.** For employees whose airborne exposure to cadmium is above the PEL, the employer shall provide clean change rooms, handwashing facilities, showers, and lunchroom facilities that comply with WAC 296-24-120 and 296-800-230.

(2) **Change rooms.** The employer shall assure that change rooms are equipped with separate storage facilities for street clothes and for protective clothing and equipment, which are designed to prevent dispersion of cadmium and contamination of the employee's street clothes.

(3) **Showers and handwashing facilities.**

(a) The employer shall assure that employees who are exposed to cadmium above the PEL shower during the end of the work shift.

(b) The employer shall assure that employees whose airborne exposure to cadmium is above the PEL wash their hands and faces prior to eating, drinking, smoking, chewing tobacco or gum, or applying cosmetics.

(4) **Lunchroom facilities.**

(a) The employer shall assure that the lunchroom facilities are readily accessible to employees, that tables for eating are maintained free of cadmium, and that no employee in a lunchroom facility is exposed at any time to cadmium at or above a concentration of 2.5 $\mu g/m^3$.

(b) The employer shall assure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface cadmium has been removed from the clothing and equipment by HEPA vacuuming or some other method that removes cadmium dust without dispersing it.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07419, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07419, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07421 Housekeeping.

(1) All surfaces shall be maintained as free as practicable of accumulations of cadmium.

(2) All spills and sudden releases of material containing cadmium shall be cleaned up as soon as possible.

(3) Surfaces contaminated with cadmium shall, wherever possible, be cleaned by vacuuming or other methods that minimize the likelihood of cadmium becoming airborne.

WAC 296-62-07421 (Cont.)

(4) HEPA-filtered vacuuming equipment or equally effective filtration methods shall be used for vacuuming. The equipment shall be used and emptied in a manner that minimizes the reentry of cadmium into the workplace.

(5) Shoveling, dry or wet sweeping, and brushing may be used only where vacuuming or other methods that minimize the likelihood of cadmium becoming airborne have been tried and found not to be effective.

(6) Compressed air shall not be used to remove cadmium from any surface unless the compressed air is used in conjunction with a ventilation system designed to capture the dust cloud created by the compressed air.

(7) Waste, scrap, debris, bags, containers, personal protective equipment, and clothing contaminated with cadmium and consigned for disposal must be collected and disposed of in sealed impermeable bags or other closed, impermeable containers. These bags and containers must be labeled in accordance with WAC 296-62-07425(3).

[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20), § 296-62-07421, filed 06/05/02, effective 08/01/02. Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07421, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07423 Medical surveillance.

(1) **General.**

(a) Scope.

(i) Currently exposed. The employer shall institute a medical surveillance program for all employees who are or may be exposed to cadmium at or above the action level unless the employer demonstrates that the employee is not, and will not be, exposed at or above the action level on thirty or more days per year (twelve consecutive months); and

(ii) Previously exposed. The employer shall also institute a medical surveillance program for all employees who prior to the effective date of this section might previously have been exposed to cadmium at or above the action level by the employer, unless the employer demonstrates that the employee did not prior to the effective date of this section work for the employer in jobs with exposure to cadmium for an aggregated total of more than sixty months.

(b) To determine an employee's fitness for using a respirator, the employer shall provide the limited medical examination specified in subsection (6) of this section.

(c) The employer shall assure that all medical examinations and procedures required by this standard are performed by or under the supervision of a licensed physician, who has read and is familiar with the health effects WAC 296-62-07441, Appendix A, the regulatory text of this section, the protocol for sample handling and laboratory selection in WAC 296-62-07451, Appendix F and the questionnaire of WAC 296-62-07447, Appendix D. These examinations and procedures shall be provided without cost to the employee and at a time and place that is reasonable and convenient to employees.

(d) The employer shall assure that the collecting and handling of biological samples of cadmium in urine (CdU), cadmium in blood (CdB), and beta-2 microglobulin in urine (ß2-M) taken from employees under this section is done in a manner that assures their reliability and that analysis of biological samples of cadmium in urine (CdU), cadmium in blood (CdB), and beta-2 microglobulin in urine (ß2-M) taken from employees under this section is performed in laboratories with demonstrated proficiency for that particular analyte. (See WAC 296-62-07451, Appendix F.)

WAC 296-62-07423 (Cont.)

(2) **Initial examination.**

(a) The employer shall provide an initial (preplacement) examination to all employees covered by the medical surveillance program required in subsection (1)(a) of this section. The examination shall be provided to those employees within thirty days after initial assignment to a job with exposure to cadmium or no later than ninety days after the effective date of this section, whichever date is later.

(b) The initial (preplacement) medical examination shall include:

(i) A detailed medical and work history, with emphasis on: Past, present, and anticipated future exposure to cadmium; any history of renal, cardiovascular, respiratory, hematopoietic, reproductive, and/or musculo-skeletal system dysfunction; current usage of medication with potential nephrotoxic side-effects; and smoking history and current status; and

(ii) Biological monitoring that includes the following tests:

(A) Cadmium in urine (CdU), standardized to grams of creatinine (g/Cr);

(B) Beta-2 microglobulin in urine (ß2-M), standardized to grams of creatinine (g/Cr), with pH specified, as described in WAC 296-62-07451, Appendix F; and

(C) Cadmium in blood (CdB), standardized to liters of whole blood (lwb).

(c) Recent examination: An initial examination is not required to be provided if adequate records show that the employee has been examined in accordance with the requirements of (b) of this subsection within the past twelve months. In that case, such records shall be maintained as part of the employee's medical record and the prior exam shall be treated as if it were an initial examination for the purposes of subsections (3) and (4) of this section.

(3) **Actions triggered by initial biological monitoring:**

(a) If the results of the initial biological monitoring tests show the employee's CdU level to be at or below 3 µg/g Cr, ß2-M level to be at or below 300 µg/g Cr and CdB level to be at or below 5 µg/lwb, then:

(i) For currently exposed employees, who are subject to medical surveillance under subsection (1)(a)(i) of this section, the employer shall provide the minimum level of periodic medical surveillance in accordance with the requirements in subsection (4)(a) of this section; and

(ii) For previously exposed employees, who are subject to medical surveillance under subsection (1)(a)(ii) of this section, the employer shall provide biological monitoring for CdU, ß2-M, and CdB one year after the initial biological monitoring and then the employer shall comply with the requirements of subsection (4)(e) of this section.

(b) For all employees who are subject to medical surveillance under subsection (1)(a) of this section, if the results of the initial biological monitoring tests show the level of CdU to exceed 3 µg/g Cr, the level of ß2-M to exceed 300 µg/g Cr, or the level of CdB to exceed 5 µg/lwb, the employer shall:

(i) Within two weeks after receipt of biological monitoring results, reassess the employee's occupational exposure to cadmium as follows:

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(A) Reassess the employee's work-practices and personal hygiene;

(B) Reevaluate the employee's respirator use, if any, and the respirator program;

(C) Review the hygiene facilities;

(D) Reevaluate the maintenance and effectiveness of the relevant engineering controls;

(E) Assess the employee's smoking history and status;

(ii) Within thirty days after the exposure reassessment, specified in (b)(i) of this subsection, take reasonable steps to correct any deficiencies found in the reassessment that may be responsible for the employee's excess exposure to cadmium; and,

(iii) Within ninety days after receipt of biological monitoring results, provide a full medical examination to the employee in accordance with the requirements of WAC 296-62-07423 (4)(b). After completing the medical examination, the examining physician shall determine in a written medical opinion whether to medically remove the employee. If the physician determines that medical removal is not necessary, then until the employee's CdU level falls to or below 3 µg/g Cr, ß2-M level falls to or below 300 µg/g Cr and CdB level falls to or below 5 µg/lwb, the employer shall:

(A) Provide biological monitoring in accordance with subsection (2)(b)(ii) of this section on a semiannual basis; and

(B) Provide annual medical examinations in accordance with subsection (4)(b) of this section.

(c) For all employees who are subject to medical surveillance under subsection (1)(a) of this section, if the results of the initial biological monitoring tests show the level of CdU to be in excess of 15 µg/g Cr, or the level of CdB to be in excess of 15 µg/lwb, or the level of ß2-M to be in excess of 1,500 µg/g Cr, the employer shall comply with the requirements of (b)(i) and (ii) of this subsection. Within ninety days after receipt of biological monitoring results, the employer shall provide a full medical examination to the employee in accordance with the requirements of subsection (4)(b) of this section.

After completing the medical examination, the examining physician shall determine in a written medical opinion whether to medically remove the employee. However, if the initial biological monitoring results and the biological monitoring results obtained during the medical examination both show that: CdU exceeds 15 µg/g Cr; or CdB exceeds 15 µg/lwb; or ß2-M exceeds 1500 µg/g Cr, and in addition CdU exceeds 3 µg/g Cr or CdB exceeds 5 µg/liter of whole blood, then the physician shall medically remove the employee from exposure to cadmium at or above the action level. If the second set of biological monitoring results obtained during the medical examination does not show that a mandatory removal trigger level has been exceeded, then the employee is not required to be removed by the mandatory provisions of this section. If the employee is not required to be removed by the mandatory provisions of this section or by the physician's determination, then until the employee's CdU level falls to or below 3 µg/g Cr, ß2-M level falls to or below 300 µg/g Cr and CdB level falls to or below 5 µg/lwb, the employer shall:

(i) Periodically reassess the employee's occupational exposure to cadmium;

(ii) Provide biological monitoring in accordance with subsection (2)(b)(ii) of this section on a quarterly basis; and

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(iii) Provide semiannual medical examinations in accordance with subsection (4)(b) of this section.

(d) For all employees to whom medical surveillance is provided, beginning on January 1, 1999, and in lieu of (a) through (c) of this subsection:

(i) If the results of the initial biological monitoring tests show the employee's CdU level to be at or below 3 µg/g Cr, ß2-M level to be at or below 300 µg/g Cr and CdB level to be at or below 5 µg/lwb, then for currently exposed employees, the employer shall comply with the requirements of (a)(i) of this subsection and for previously exposed employees, the employer shall comply with the requirements of (a)(ii) of this subsection;

(ii) If the results of the initial biological monitoring tests show the level of CdU to exceed 3 µg/g Cr, the level of ß2-M to exceed 300 µg/g Cr, or the level of CdB to exceed 5 µg/lwb, the employer shall comply with the requirements of (b)(i) through (iii) of this subsection; and

(iii) If the results of the initial biological monitoring tests show the level of CdU to be in excess of 7 µg/g Cr, or the level of CdB to be in excess of 10 µg/lwb, or the level of ß2-M to be in excess of 750 µg/g Cr, the employer shall: Comply with the requirements of (b)(i) through (ii) of this subsection; and, within ninety days after receipt of biological monitoring results, provide a full medical examination to the employee in accordance with the requirements of subsection (4)(b) of this section. After completing the medical examination, the examining physician shall determine in a written medical opinion whether to medically remove the employee. However, if the initial biological monitoring results and the biological monitoring results obtained during the medical examination both show that: CdU exceeds 7 µg/g Cr; or CdB exceeds 10 µg/lwb; or ß2-M exceeds 750 µg/g Cr, and in addition CdU exceeds 3 µg/g Cr or CdB exceeds 5 µg/liter of whole blood, then the physician shall medically remove the employee from exposure to cadmium at or above the action level. If the second set of biological monitoring results obtained during the medical examination does not show that a mandatory removal trigger level has been exceeded, then the employee is not required to be removed by the mandatory provisions of this section. If the employee is not required to be removed by the mandatory provisions of this section or by the physician's determination, then until the employee's CdU level falls to or below 3 µg/g Cr, ß2-M level falls to or below 300 µg/g Cr and CdB level falls to or below 5 µg/lwb, the employer shall: periodically reassess the employee's occupational exposure to cadmium; provide biological monitoring in accordance with subsection (2)(b)(ii) of this section on a quarterly basis; and provide semiannual medical examinations in accordance with subsection (4)(b) of this section.

(4) **Periodic medical surveillance.**

(a) For each employee who is covered under subsection (1)(a)(i) of this section, the employer shall provide at least the minimum level of periodic medical surveillance, which consists of periodic medical examinations and periodic biological monitoring. A periodic medical examination shall be provided within one year after the initial examination required by subsection (2) of this section and thereafter at least biennially. Biological sampling shall be provided at least annually, either as part of a periodic medical examination or separately as periodic biological monitoring.

(b) The periodic medical examination shall include:

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(i) A detailed medical and work history, or update thereof, with emphasis on: Past, present and anticipated future exposure to cadmium; smoking history and current status; reproductive history; current use of medications with potential nephrotoxic side-effects; any history of renal, cardiovascular, respiratory, hematopoietic, and/or musculo-skeletal system dysfunction; and as part of the medical and work history, for employees who wear respirators, questions 3-11 and 25-32 in WAC 296-62-07447, Appendix D;

(ii) A complete physical examination with emphasis on: Blood pressure, the respiratory system, and the urinary system;

(iii) A 14 inch by 17 inch, or a reasonably standard sized posterior-anterior chest X-ray (after the initial X-ray, the frequency of chest X-rays is to be determined by the examining physician);

(iv) Pulmonary function tests, including forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV_1);

(v) Biological monitoring, as required in subsection (2)(b)(ii) of this section;

(vi) Blood analysis, in addition to the analysis required under this section, including blood urea nitrogen, complete blood count, and serum creatinine;

(vii) Urinalysis, in addition to the analysis required under subsection (2)(b)(ii) of this section, including the determination of albumin, glucose, and total and low molecular weight proteins;

(viii) For males over forty years old, prostate palpation, or other at least as effective diagnostic test(s); and

(ix) Any additional tests deemed appropriate by the examining physician.

(c) Periodic biological monitoring shall be provided in accordance with subsection (2)(b)(ii) of this section.

(d) If the results of periodic biological monitoring or the results of biological monitoring performed as part of the periodic medical examination show the level of the employee's CdU, ß2-M, or CdB to be in excess of the levels specified in subsection (3)(b) or (c) of this section; or, beginning on January 1, 1999, in excess of the levels specified in subsection (3)(b) or (d) of this section, the employer shall take the appropriate actions specified in subsection (3)(b) through (d) of this section.

(e) For previously exposed employees under subsection (1)(a)(ii) of this section:

(i) If the employee's levels of CdU did not exceed 3 µg/g Cr, CdB did not exceed 5 µg/lwb, and ß2-M did not exceed 300 µg/g Cr in the initial biological monitoring tests, and if the results of the follow-up biological monitoring required by subsection (3)(a)(ii) of this section one year after the initial examination confirm the previous results, the employer may discontinue all periodic medical surveillance for that employee.

(ii) If the initial biological monitoring results for CdU, CdB, or ß2-M were in excess of the levels specified in subsection (3)(a) of this section, but subsequent biological monitoring results required by subsection (3)(b) through (e) of this section show that the employee's CdU levels no longer exceed 3 µg/g Cr, CdB levels no longer exceed 5 µg/lwb, and

ß2-M levels no longer exceed 300 µg/g Cr, the employer shall provide biological monitoring for CdU, CdB, and ß2-M one year after these most recent biological monitoring results. If the results of the follow-up biological monitoring, specified in this section, confirm the previous results, the employer may discontinue all periodic medical surveillance for that employee.

(iii) However, if the results of the follow-up tests specified in (e)(i) or (ii) of this subsection indicate that the level of the employee's CdU, ß2-M, or CdB exceeds these same levels, the employer is required to provide annual medical examinations in accordance with the provisions of (b) of this subsection until the results of biological monitoring are consistently below these levels or the examining physician determines in a written medical opinion that further medical surveillance is not required to protect the employee's health.

(f) A routine, biennial medical examination is not required to be provided in accordance with subsections (3)(a) and (4) of this section if adequate medical records show that the employee has been examined in accordance with the requirements of (b) of this subsection within the past twelve months. In that case, such records shall be maintained by the employer as part of the employee's medical record, and the next routine, periodic medical examination shall be made available to the employee within two years of the previous examination.

(5) **Actions triggered by medical examinations.** If the results of a medical examination carried out in accordance with this section indicate any laboratory or clinical finding consistent with cadmium toxicity that does not require employer action under subsections (2), (3), or (4) of this section, the employer, within thirty days, shall reassess the employee's occupational exposure to cadmium and take the following corrective action until the physician determines they are no longer necessary:

(a) Periodically reassess: The employee's work-practices and personal hygiene; the employee's respirator use, if any; the employee's smoking history and status; the respiratory protection program; the hygiene facilities; and the maintenance and effectiveness of the relevant engineering controls;

(b) Within thirty days after the reassessment, take all reasonable steps to correct the deficiencies found in the reassessment that may be responsible for the employee's excess exposure to cadmium;

(c) Provide semiannual medical reexaminations to evaluate the abnormal clinical sign(s) of cadmium toxicity until the results are normal or the employee is medically removed; and

(d) Where the results of tests for total proteins in urine are abnormal, provide a more detailed medical evaluation of the toxic effects of cadmium on the employee's renal system.

(6) **Examination for respirator use.**

(a) To determine an employee's fitness for respirator use, the employer shall provide a medical examination that includes the elements specified in (a)(i) through (iv) of this subsection. This examination shall be provided prior to the employee's being assigned to a job that requires the use of a respirator or no later than ninety days after this section goes into effect, whichever date is later, to any employee without a medical examination within the preceding twelve months that satisfies the requirements of this paragraph.

(i) A detailed medical and work history, or update thereof, with emphasis on: Past exposure to cadmium; smoking history and current status; any history of renal, cardiovascular, respiratory, hematopoietic, and/or musculoskeletal system dysfunction; a description of

the job for which the respirator is required; and questions 3 through 11 and 25 through 32 in WAC 296-62-07447, Appendix D;

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(ii) A blood pressure test;

(iii) Biological monitoring of the employee's levels of CdU, CdB and ß2-M in accordance with the requirements of subsection (2)(b)(ii) of this section, unless such results already have been obtained within the previous twelve months; and

(iv) Any other test or procedure that the examining physician deems appropriate.

(b) After reviewing all the information obtained from the medical examination required in (a) of this subsection, the physician shall determine whether the employee is fit to wear a respirator.

(c) Whenever an employee has exhibited difficulty in breathing during a respirator fit test or during use of a respirator, the employer, as soon as possible, shall provide the employee with a periodic medical examination in accordance with subsection (4)(b) of this section to determine the employee's fitness to wear a respirator.

(d) Where the results of the examination required under (a), (b), or (c) of this subsection are abnormal, medical limitation or prohibition of respirator use shall be considered. If the employee is allowed to wear a respirator, the employee's ability to continue to do so shall be periodically evaluated by a physician.

(7) **Emergency examinations.**

(a) In addition to the medical surveillance required in subsections (2) through (6) of this section, the employer shall provide a medical examination as soon as possible to any employee who may have been acutely exposed to cadmium because of an emergency.

(b) The examination shall include the requirements of subsection (4)(b) of this section, with emphasis on the respiratory system, other organ systems considered appropriate by the examining physician, and symptoms of acute overexposure, as identified in WAC 296-62-07441 (2)(b)(i) through (ii) and (4), Appendix A.

(8) **Termination of employment examination.**

(a) At termination of employment, the employer shall provide a medical examination in accordance with subsection (4)(b) of this section, including a chest x-ray, to any employee to whom at any prior time the employer was required to provide medical surveillance under subsection (1)(a) or (7) of this section. However, if the last examination satisfied the requirements of subsection (4)(b) of this section and was less than six months prior to the date of termination, no further examination is required unless otherwise specified in subsection (3) or (5) of this section;

(b) However, for employees covered by subsection (1)(a)(ii) of this section, if the employer has discontinued all periodic medical surveillance under subsection (4)(e) of this section, no termination of employment medical examination is required.

(9) **Information provided to the physician.** The employer shall provide the following information to the examining physician:

(a) A copy of this standard and appendices;

(b) A description of the affected employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to cadmium;

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(c) The employee's former, current, and anticipated future levels of occupational exposure to cadmium;

(d) A description of any personal protective equipment, including respirators, used or to be used by the employee, including when and for how long the employee has used that equipment; and

(e) Relevant results of previous biological monitoring and medical examinations.

(10) **Physician's written medical opinion.**

(a) The employer shall promptly obtain a written, signed medical opinion from the examining physician for each medical examination performed on each employee. This written opinion shall contain:

(i) The physician's diagnosis for the employee;

(ii) The physician's opinion as to whether the employee has any detected medical condition(s) that would place the employee at increased risk of material impairment to health from further exposure to cadmium, including any indications of potential cadmium toxicity;

(iii) The results of any biological or other testing or related evaluations that directly assess the employee's absorption of cadmium;

(iv) Any recommended removal from, or limitation on the activities or duties of the employee or on the employee's use of personal protective equipment, such as respirators;

(v) A statement that the physician has clearly and carefully explained to the employee the results of the medical examination, including all biological monitoring results and any medical conditions related to cadmium exposure that require further evaluation or treatment, and any limitation on the employee's diet or use of medications.

(b) The employer promptly shall obtain a copy of the results of any biological monitoring provided by an employer to an employee independently of a medical examination under subsections (2) and (4) of this section, and, in lieu of a written medical opinion, an explanation sheet explaining those results.

(c) The employer shall instruct the physician not to reveal orally or in the written medical opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to cadmium.

(11) **Medical removal protection (MRP).**

(a) General.

(i) The employer shall temporarily remove an employee from work where there is excess exposure to cadmium on each occasion that medical removal is required under subsection (3), (4), or (6) of this section and on each occasion that a physician determines in a written medical opinion that the employee should be removed from such exposure. The physician's determination may be based on biological monitoring results, inability to wear a respirator, evidence of illness, other signs or symptoms of cadmium-related dysfunction or disease, or any other reason deemed medically sufficient by the physician.

(ii) The employer shall medically remove an employee in accordance with this subsection regardless of whether at the time of removal a job is available into which the removed employee may be transferred.

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(iii) Whenever an employee is medically removed under this subsection, the employer shall transfer the removed employee to a job where the exposure to cadmium is within the permissible levels specified in that subsection as soon as one becomes available.

(iv) For any employee who is medically removed under the provisions of (a) of this subsection, the employer shall provide follow-up biological monitoring in accordance with subsection (2)(b)(ii) of this section at least every three months and follow-up medical examinations semiannually at least every six months until in a written medical opinion the examining physician determines that either the employee may be returned to his/her former job status as specified under (d) through (e) of this subsection or the employee must be permanently removed from excess cadmium exposure.

(v) The employer may not return an employee who has been medically removed for any reason to his/her former job status until a physician determines in a written medical opinion that continued medical removal is no longer necessary to protect the employee's health.

(b) Where an employee is found unfit to wear a respirator under subsection (6)(b) of this section, the employer shall remove the employee from work where exposure to cadmium is above the PEL.

(c) Where removal is based on any reason other than the employee's inability to wear a respirator, the employer shall remove the employee from work where exposure to cadmium is at or above the action level.

(d) Except as specified in (e) of this subsection, no employee who was removed because his/her level of CdU, CdB and/or ß2-M exceeded the medical removal trigger levels in subsection (3) or (4) of this section may be returned to work with exposure to cadmium at or above the action level until the employee's levels of CdU fall to or below 3 µg/g Cr, CdB falls to or below 5 µg/lwb, and ß2-M falls to or below 300 µg/g Cr.

(e) However, when in the examining physician's opinion continued exposure to cadmium will not pose an increased risk to the employee's health and there are special circumstances that make continued medical removal an inappropriate remedy, the physician shall fully discuss these matters with the employee, and then in a written determination may return a worker to his/her former job status despite what would otherwise be unacceptably high biological monitoring results. Thereafter, the returned employee shall continue to be provided with medical surveillance as if he/she were still on medical removal until the employee's levels of CdU fall to or below 3 µg/g Cr, CdB falls to or below 5 µg/lwb, and ß2-M falls to or below 300 µg/g Cr.

(f) Where an employer, although not required by (a) through (c) of this subsection to do so, removes an employee from exposure to cadmium or otherwise places limitations on an employee due to the effects of cadmium exposure on the employee's medical condition, the employer shall provide the same medical removal protection benefits to that employee under subsection (12) of this section as would have been provided had the removal been required under (a) through (c) of this subsection.

(12) **Medical removal protection benefits (MRPB).**

(a) The employer shall provide MRPB for up to a maximum of eighteen months to an employee each time and while the employee is temporarily medically removed under subsection (11) of this section.

WAC 296-62-07423 (Cont.)

(b) For purposes of this section, the requirement that the employer provide MRPB means that the employer shall maintain the total normal earnings, seniority, and all other employee rights and benefits of the removed employee, including the employee's right to his/her former job status, as if the employee had not been removed from the employee's job or otherwise medically limited.

(c) Where, after eighteen months on medical removal because of elevated biological monitoring results, the employee's monitoring results have not declined to a low enough level to permit the employee to be returned to his/her former job status:

(i) The employer shall make available to the employee a medical examination pursuant in order to obtain a final medical determination as to whether the employee may be returned to his/her former job status or must be permanently removed from excess cadmium exposure; and

(ii) The employer shall assure that the final medical determination indicates whether the employee may be returned to his/her former job status and what steps, if any, should be taken to protect the employee's health.

(d) The employer may condition the provision of MRPB upon the employee's participation in medical surveillance provided in accordance with this section.

(13) **Multiple physician review.**

(a) If the employer selects the initial physician to conduct any medical examination or consultation provided to an employee under this section, the employee may designate a second physician to:

(i) Review any findings, determinations, or recommendations of the initial physician; and

(ii) Conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

(b) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician provided by the employer conducts a medical examination or consultation pursuant to this section. The employer may condition its participation in, and payment for, multiple physician review upon the employee doing the following within fifteen days after receipt of this notice, or receipt of the initial physician's written opinion, whichever is later:

(i) Informing the employer that he or she intends to seek a medical opinion; and

(ii) Initiating steps to make an appointment with a second physician.

(c) If the findings, determinations, or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve any disagreement.

(d) If the two physicians have been unable to quickly resolve their disagreement, then the employer and the employee, through their respective physicians, shall designate a third physician to:

(i) Review any findings, determinations, or recommendations of the other two physicians; and

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(ii) Conduct such examinations, consultations, laboratory tests, and discussions with the other two physicians as the third physician deems necessary to resolve the disagreement among them.

(e) The employer shall act consistently with the findings, determinations, and recommendations of the third physician, unless the employer and the employee reach an agreement that is consistent with the recommendations of at least one of the other two physicians.

(14) **Alternate physician determination.** The employer and an employee or designated employee representative may agree upon the use of any alternate form of physician determination in lieu of the multiple physician review provided by subsection (13) of this section, so long as the alternative is expeditious and at least as protective of the employee.

(15) **Information the employer must provide the employee.**

(a) The employer shall provide a copy of the physician's written medical opinion to the examined employee within two weeks after receipt thereof.

(b) The employer shall provide the employee with a copy of the employee's biological monitoring results and an explanation sheet explaining the results within two weeks after receipt thereof.

(c) Within thirty days after a request by an employee, the employer shall provide the employee with the information the employer is required to provide the examining physician under subsection (9) of this section.

(16) **Reporting.** In addition to other medical events that are required to be reported on the OSHA Form No. 200, the employer shall report any abnormal condition or disorder caused by occupational exposure to cadmium associated with employment as specified in WAC 296-27-060.

[Statutory Authority: Chapter 49.17 RCW. 93-21-075 (Order 93-06), § 296-62-07423, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07423, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07425 Communication of cadmium hazards to employees.

(1) **General.** In communications concerning cadmium hazards, employers shall comply with the requirements of WISHA's chemical hazard communication standard, WAC 296-800-170, including but not limited to the requirements concerning warning signs and labels, material safety data sheets (MSDS), and employee information and training. In addition, employers shall comply with the following requirements:

(2) **Warning signs.**

(a) Warning signs shall be provided and displayed in regulated areas. In addition, warning signs shall be posted at all approaches to regulated areas so that an employee may read the signs and take necessary protective steps before entering the area.

(b) Warning signs required by (a) of this subsection shall bear the following information:

DANGER CADMIUM CANCER HAZARD CAN CAUSE LUNG AND KIDNEY DISEASE AUTHORIZED PERSONNEL ONLY RESPIRATORS REQUIRED IN THIS AREA

(c) The employer shall assure that signs required by this subsection are illuminated, cleaned, and maintained as necessary so that the legend is readily visible.

WAC 296-62-07425 (Cont.)

(3) **Warning labels.**

(a) Shipping and storage containers containing cadmium, cadmium compounds, or cadmium contaminated clothing, equipment, waste, scrap, or debris shall bear appropriate warning labels, as specified in (b) of this subsection.

(b) The warning labels shall include at least the following information:

DANGER CONTAINS CADMIUM CANCER HAZARD AVOID CREATING DUST CAN CAUSE LUNG AND KIDNEY DISEASE

(c) Where feasible, installed cadmium products shall have a visible label or other indication that cadmium is present.

(4) **Employee information and training.**

(a) The employer shall institute a training program for all employees who are potentially exposed to cadmium, assure employee participation in the program, and maintain a record of the contents of such program.

(b) Training shall be provided prior to or at the time of initial assignment to a job involving potential exposure to cadmium and at least annually thereafter.

(c) The employer shall make the training program understandable to the employee and shall assure that each employee is informed of the following:

(i) The health hazards associated with cadmium exposure, with special attention to the information incorporated in WAC 296-62-07441, Appendix A;

(ii) The quantity, location, manner of use, release, and storage of cadmium in the workplace and the specific nature of operations that could result in exposure to cadmium, especially exposures above the PEL;

(iii) The engineering controls and work-practices associated with the employee's job assignment;

(iv) The measures employees can take to protect themselves from exposure to cadmium, including modification of such habits as smoking and personal hygiene, and specific procedures the employer has implemented to protect employees from exposure to cadmium such as appropriate work-practices, emergency procedures, and the provision of personal protective equipment;

(v) The purpose, proper selection, fitting, proper use, and limitations of protective clothing;

(vi) The purpose and a description of the medical surveillance program required by WAC 296-62-07423;

(vii) The contents of this section and its appendices;

(viii) The employee's rights of access to records under WAC 296-62-05213 and 296-800-170; and

WAC 296-62-07425 (Cont.)

(ix) The purpose, proper use, limitations, and other training requirements for respiratory protection as required in chapter 296-62 WAC, part E.

(d) Additional access to information and training program and materials.

(i) The employer shall make a copy of this section and its appendices readily available without cost to all affected employees and shall provide a copy if requested.

(ii) The employer shall provide to the director, upon request, all materials relating to the employee information and the training program.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07425, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07425, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 93-21-075 (Order 93-06), § 296-62-07425, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07425, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07427 Recordkeeping.

(1) **Exposure monitoring.**

(a) The employer shall establish and keep an accurate record of all air monitoring for cadmium in the workplace.

(b) This record shall include at least the following information:

(i) The monitoring date, duration, and results in terms of an 8-hour TWA of each sample taken;

(ii) The name, Social Security number, and job classification of the employees monitored and of all other employees whose exposures the monitoring is intended to represent;

(iii) A description of the sampling and analytical methods used and evidence of their accuracy;

(iv) The type of respiratory protective device, if any, worn by the monitored employee;

(v) A notation of any other conditions that might have affected the monitoring results.

(c) The employer shall maintain this record for at least thirty years, in accordance with chapter 296-62 WAC, Part B.

(2) **Objective data for exemption from requirement for initial monitoring.**

(a) For purposes of this section, objective data are information demonstrating that a particular product or material containing cadmium or a specific process, operation, or activity involving cadmium cannot release dust or fumes in concentrations at or above the action level even under the worst-case release conditions. Objective data can be obtained from an industry-wide study or from laboratory product test results from manufacturers of cadmium-containing products or materials. The data the employer uses from an industry-wide survey must be obtained under workplace conditions closely resembling the processes, types of material, control methods, work-practices and environmental conditions in the employer's current operations.

(b) The employer shall establish and maintain a record of the objective data for at least thirty years.

WAC 296-62-07427 (Cont.)

(3) **Medical surveillance.**

(a) The employer shall establish and maintain an accurate record for each employee covered by medical surveillance under WAC 296-62-07423 (1)(a).

(b) The record shall include at least the following information about the employee:

(i) Name, Social Security number, and description of the duties;

(ii) A copy of the physician's written opinions and an explanation sheet for biological monitoring results;

(iii) A copy of the medical history, and the results of any physical examination and all test results that are required to be provided by this section, including biological tests, x-rays, pulmonary function tests, etc., or that have been obtained to further evaluate any condition that might be related to cadmium exposure;

(iv) The employee's medical symptoms that might be related to exposure to cadmium; and

(v) A copy of the information provided to the physician as required by WAC 296-62-07423 (9)(b) through (e).

(c) The employer shall assure that this record is maintained for the duration of employment plus thirty years, in accordance with chapter 296-62 WAC, Part B.

(4) **Training.** The employer shall certify that employees have been trained by preparing a certification record which includes the identity of the person trained, the signature of the employer or the person who conducted the training, and the date the training was completed. The certification records shall be prepared at the completion of training and shall be maintained on file for one year beyond the date of training of that employee.

(5) **Availability.**

(a) Except as otherwise provided for in this section, access to all records required to be maintained by subsections (1) through (4) of this section shall be in accordance with the provisions of chapter 296-62 WAC, Part B.

(b) Within fifteen days after a request, the employer shall make an employee's medical records required to be kept by subsection (3) of this section available for examination and copying to the subject employee, to designated representatives, to anyone having the specific written consent of the subject employee, and after the employee's death or incapacitation, to the employee's family members.

(6) **Transfer of records.** Whenever an employer ceases to do business and there is no successor employer to receive and retain records for the prescribed period or the employer intends to dispose of any records required to be preserved for at least thirty years, the employer shall comply with the requirements concerning transfer of records set forth in WAC 296-62-05215.

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07427, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07429 Observation of monitoring.

(1) **Employee observation.** The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to cadmium.

WAC 296-62-07429 (Cont.)

(2) **Observation procedures.** When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the observer with that clothing and equipment and shall assure that the observer uses such clothing and equipment and complies with all other applicable safety and health procedures.

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07429, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07433 Appendices. WAC 296-62-07441, appendix A; WAC 296-62-07443, appendix B; WAC 296-62-07447, appendix D; WAC 296-62-07449, appendix E; and WAC 296-62-07451, appendix F are nonmandatory appendices and are not intended to create any additional obligations.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-17-094 (Order 99-01), § 296-62-07433, filed 08/17/99, effective 12/01/99. Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07433, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07441 Appendix A--substance safety data sheet--Cadmium.

(1) **Substance identification.**

(a) Substance: Cadmium.

(b) 8-Hour, time-weighted-average, permissible exposure limit (TWA PEL):

(c) TWA PEL: Five micrograms of cadmium per cubic meter of air 5 $\mu g/m^3$, time-weighted average (TWA) for an 8-hour workday.

(d) Appearance: Cadmium metal--soft, blue-white, malleable, lustrous metal or grayish-white powder. Some cadmium compounds may also appear as a brown, yellow, or red powdery substance.

(2) **Health hazard data.**

(a) Routes of exposure. Cadmium can cause local skin or eye irritation. Cadmium can affect your health if you inhale it or if you swallow it.

(b) Effects of overexposure.

(i) Short-term (acute) exposure: Cadmium is much more dangerous by inhalation than by ingestion. High exposures to cadmium that may be immediately dangerous to life or health occur in jobs where workers handle large quantities of cadmium dust or fume; heat cadmium-containing compounds or cadmium-coated surfaces; weld with cadmium solders or cut cadmium-containing materials such as bolts.

(ii) Severe exposure may occur before symptoms appear. Early symptoms may include mild irritation of the upper respiratory tract, a sensation of constriction of the throat, a metallic taste and/or a cough. A period of one to ten hours may precede the onset of rapidly progressing shortness of breath, chest pain, and flu-like symptoms with weakness, fever, headache, chills, sweating, and muscular pain. Acute pulmonary edema usually develops within twenty-four hours and reaches a maximum by three days. If death from asphyxia does not occur, symptoms may resolve within a week.

(iii) Long-term (chronic) exposure. Repeated or long-term exposure to cadmium, even at relatively low concentrations, may result in kidney damage and an increased risk of cancer of the lung and of the prostate.

(c) Emergency first aid procedures.

WAC 296-62-07441 (Cont.)

(i) Eye exposure: Direct contact may cause redness or pain. Wash eyes immediately with large amounts of water, lifting the upper and lower eyelids. Get medical attention immediately.

(ii) Skin exposure: Direct contact may result in irritation. Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water. Get medical attention immediately.

(iii) Ingestion: Ingestion may result in vomiting, abdominal pain, nausea, diarrhea, headache, and sore throat. Treatment for symptoms must be administered by medical personnel. Under no circumstances should the employer allow any person whom he/she retains, employs, supervises, or controls to engage in therapeutic chelation. Such treatment is likely to translocate cadmium from pulmonary or other tissue to renal tissue. Get medical attention immediately.

(iv) Inhalation: If large amounts of cadmium are inhaled, the exposed person must be moved to fresh air at once. If breathing has stopped, perform cardiopulmonary resuscitation. Administer oxygen if available. Keep the affected person warm and at rest. Get medical attention immediately.

(v) Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, attempt rescue only after notifying at least one other person of the emergency and putting into effect established emergency procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the location of the emergency equipment before the need arises.

(3) **Employee information.**

(a) Protective clothing and equipment.

(i) Respirators: You may be required to wear a respirator for nonroutine activities; in emergencies; while your employer is in the process of reducing cadmium exposures through engineering controls; and where engineering controls are not feasible. If air-purifying respirators are worn , they must have a label issued by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84 stating that the respirators have been certified for use with cadmium. Cadmium does not have a detectable odor except at levels well above the permissible exposure limits. If you can smell cadmium while wearing a respirator, proceed immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

(ii) Protective clothing: You may be required to wear impermeable clothing, gloves, foot gear, a face shield, or other appropriate protective clothing to prevent skin contact with cadmium. Where protective clothing is required, your employer must provide clean garments to you as necessary to assure that the clothing protects you adequately. The employer must replace or repair protective clothing that has become torn or otherwise damaged.

(iii) Eye protection: You may be required to wear splash-proof or dust resistant goggles to prevent eye contact with cadmium.

(b) Employer requirements.

WAC 296-62-07441 (Cont.)

(i) Medical: If you are exposed to cadmium at or above the action level, your employer is required to provide a medical examination, laboratory tests and a medical history according to the medical surveillance provisions under WAC 296-62-07423. (See summary chart and tables in this section, appendix A.) These tests shall be provided without cost to you. In addition, if you are accidentally exposed to cadmium under conditions known or suspected to constitute toxic exposure to cadmium, your employer is required to make special tests available to you.

(ii) Access to records: All medical records are kept strictly confidential. You or your representative are entitled to see the records of measurements of your exposure to cadmium. Your medical examination records can be furnished to your personal physician or designated representative upon request by you to your employer.

(iii) Observation of monitoring: Your employer is required to perform measurements that are representative of your exposure to cadmium and you or your designated representative are entitled to observe the monitoring procedure. You are entitled to observe the steps taken in the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you or your representative must also be provided with, and must wear the protective clothing and equipment.

(c) Employee requirements. You will not be able to smoke, eat, drink, chew gum or tobacco, or apply cosmetics while working with cadmium in regulated areas. You will also not be able to carry or store tobacco products, gum, food, drinks, or cosmetics in regulated areas because these products easily become contaminated with cadmium from the workplace and can therefore create another source of unnecessary cadmium exposure. Some workers will have to change out of work clothes and shower at the end of the day, as part of their workday, in order to wash cadmium from skin and hair. Handwashing and cadmium-free eating facilities shall be provided by the employer and proper hygiene should always be performed before eating. It is also recommended that you do not smoke or use tobacco products, because among other things, they naturally contain cadmium. For further information, read the labeling on such products.

(4) **Physician information.**

(a) Introduction. The medical surveillance provisions of WAC 296-62-07423 generally are aimed at accomplishing three main interrelated purposes: First, identifying employees at higher risk of adverse health effects from excess, chronic exposure to cadmium; second, preventing cadmium-induced disease; and third, detecting and minimizing existing cadmium-induced disease. The core of medical surveillance in this standard is the early and periodic monitoring of the employee's biological indicators of:

(i) Recent exposure to cadmium;

(ii) Cadmium body burden; and

(iii) Potential and actual kidney damage associated with exposure to cadmium. The main adverse health effects associated with cadmium overexposure are lung cancer and kidney dysfunction. It is not yet known how to adequately biologically monitor human beings to specifically prevent cadmium-induced lung cancer. By contrast, the kidney can be monitored to provide prevention and early detection of cadmium-induced kidney damage. Since, for noncarcinogenic effects, the kidney is considered the primary target organ of chronic exposure to cadmium, the medical surveillance provisions of this standard effectively focus on cadmium-induced kidney disease. Within that focus, the

aim, where possible, is to prevent the onset of such disease and, where necessary, to minimize such disease as may already exist. The by-products of successful prevention of kidney disease are anticipated to be the reduction and prevention of other cadmium-induced diseases.

(b) Health effects. The major health effects associated with cadmium overexposure are described below.

(i) Kidney: The most prevalent nonmalignant disease observed among workers chronically exposed to cadmium is kidney dysfunction. Initially, such dysfunction is manifested as proteinuria. The proteinuria associated with cadmium exposure is most commonly characterized by excretion of low-molecular weight proteins (15,000 to 40,000 MW) accompanied by loss of electrolytes, uric acid, calcium, amino acids, and phosphate. The compounds commonly excreted include: beta-2-microglobulin (ß2-M), retinol binding protein (RBP), immunoglobulin light chains, and lysozyme. Excretion of low molecular weight proteins are characteristic of damage to the proximal tubules of the kidney (Iwao et al., 1980). It has also been observed that exposure to cadmium may lead to urinary excretion of high-molecular weight proteins such as albumin, immunoglobulin G, and glycoproteins (Ex. 29). Excretion of high-molecular weight proteins is typically indicative of damage to the glomeruli of the kidney. Bernard et al., (1979) suggest that damage to the glomeruli and damage to the proximal tubules of the kidney may both be linked to cadmium exposure but they may occur independently of each other. Several studies indicate that the onset of low-molecular weight proteinuria is a sign of irreversible kidney damage (Friberg et al., 1974; Roels et al., 1982; Piscator 1984; Elinder et al., 1985; Smith et al., 1986). Above specific levels of ß2-M associated with cadmium exposure it is unlikely that ß2-M levels return to normal even when cadmium exposure is eliminated by removal of the individual from the cadmium work environment (Friberg, Ex. 29, 1990). Some studies indicate that such proteinuria may be progressive; levels of ß2-M observed in the urine increase with time even after cadmium exposure has ceased. See, for example, Elinder et al., 1985. Such observations, however, are not universal, and it has been suggested that studies in which proteinuria has not been observed to progress may not have tracked patients for a sufficiently long time interval (Jarup, Ex. 8-661). When cadmium exposure continues after the onset of proteinuria, chronic nephrotoxicity may occur (Friberg, Ex. 29). Uremia results from the inability of the glomerulus to adequately filter blood. This leads to severe disturbance of electrolyte concentrations and may lead to various clinical complications including kidney stones (L-140-50). After prolonged exposure to cadmium, glomerular proteinuria, glucosuria, aminoaciduria, phosphaturia, and hypercalciuria may develop (Exs. 8-86, 4-28, 14-18). Phosphate, calcium, glucose, and amino acids are essential to life, and under normal conditions, their excretion should be regulated by the kidney. Once low molecular weight proteinuria has developed, these elements dissipate from the human body. Loss of glomerular function may also occur, manifested by decreased glomerular filtration rate and increased serum creatinine. Severe cadmium-induced renal damage may eventually develop into chronic renal failure and uremia (Ex. 55). Studies in which animals are chronically exposed to cadmium confirm the renal effects observed in humans (Friberg et al., 1986). Animal studies also confirm problems with calcium metabolism and related skeletal effects which have been observed among humans exposed to cadmium in addition to the renal effects. Other effects commonly reported in chronic animal studies include anemia, changes in liver morphology, immunosuppression and hypertension. Some of these effects may be associated with co-factors. Hypertension, for example, appears to be associated with diet as well as cadmium exposure. Animals injected with cadmium have also shown testicular necrosis (Ex. 8- 86B).

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(ii) Biological markers. It is universally recognized that the best measures of cadmium exposures and its effects are measurements of cadmium in biological fluids, especially urine and blood. Of the two, CdU is conventionally used to determine body burden of cadmium in workers without kidney disease. CdB is conventionally used to monitor for recent exposure to cadmium. In addition, levels of CdU and CdB historically have been used to predict the percent of the population likely to develop kidney disease (Thun et al., Ex. L-140-50; WHO, Ex. 8-674; ACGIH, Exs. 8-667, 140-50). The third biological parameter upon which WISHA relies for medical surveillance is beta-2-microglobulin in urine (ß2-M), alow molecular weight protein. Excess ß2-M has been widely accepted by physicians and scientists as a reliable indicator of functional damage to the proximal tubule of the kidney

(Exs. 8-447, 144-3-C, 4-47, L-140-45, 19-43-A). Excess ß2-M is found when the proximal tubules can no longer reabsorb this protein in a normal manner. This failure of the proximal tubules is an early stage of a kind of kidney disease that commonly occurs among workers with excessive cadmium exposure. Used in conjunction with biological test results indicating abnormal levels of CdU and CdB, the finding of excess ß2-M can establish for an examining physician that any existing kidney disease is probably cadmium-related (Trs. 6/6/90, pp. 82-86, 122, 134). The upper limits of normal levels for cadmium in urine and cadmium in blood are 3 µg Cd/gram creatinine in urine and 5 µg Cd/liter whole blood, respectively. These levels were derived from broad-based population studies. Three issues confront the physicians in the use of ß2-M as a marker of kidney dysfunction and material impairment. First, there are a few other causes of elevated levels of ß2-M not related to cadmium exposures, some of which may be rather common diseases and some of which are serious diseases (e.g., myeloma or transient flu, Exs. 29 and 8-086). These can be medically evaluated as alternative causes (Friberg, Ex. 29). Also, there are other factors that can cause ß2-M to degrade so that low levels would result in workers with tubular dysfunction. For example, regarding the degradation of ß2-M, workers with acidic urine (pH<6) might have ß2-M levels that are within the “normal” range when in fact kidney dysfunction has occurred (Ex. L-140-1) and the low molecular weight proteins are degraded in acid urine.

Thus, it is very important that the pH of urine be measured, that urine samples be buffered as necessary (See WAC 296-62-07451, appendix F.), and that urine samples be handled correctly, i.e., measure the pH of freshly voided urine samples, then if necessary, buffer to Ph>6 (or above for shipping purposes), measure Ph again and then, perhaps, freeze the sample for storage and shipping. (See also WAC 296-62-07451, appendix F.) Second, there is debate over the pathological significance of proteinuria, however, most world experts believe that ß2-M levels greater than 300 µg/g Cr are abnormal (Elinder, Ex. 55, Friberg, Ex. 29). Such levels signify kidney dysfunction that constitutes material impairment of health. Finally, detection of ß2-M at low levels has often been considered difficult, however, many laboratories have the capability of detecting excess ß2-M using simple kits, such as the Phadebas Delphia test, that are accurate to levels of 100 µg ß2-M/g Cr U (Ex. L-140-1). Specific recommendations for ways to measure ß2-M and proper handling of urine samples to prevent degradation of ß2-M have been addressed by WISHA in WAC 296-62-07451, appendix F, in the section on laboratory standardization. All biological samples must be analyzed in a laboratory that is proficient in the analysis of that particular analyte, under WAC 296-62-07423 (1)(d). (See WAC 296-62-07451, appendix F). Specifically, under WAC 296-62-07423 (1)(d), the employer is to assure that the collecting and handling of biological samples of cadmium in urine (CdU), cadmium in blood (CdB), and beta-2 microglobulin in urine (ß2-M) taken from employees is collected in a manner that assures reliability. The employer must also assure that analysis of biological samples of cadmium in urine (CdU), cadmium in blood

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(CdB), and beta-2 microglobulin in urine (ß2-M) taken from employees is performed in laboratories with demonstrated proficiency for that particular analyte. (See WAC 296-62-07451, appendix F).

(iii) Lung and prostate cancer. The primary sites for cadmium-associated cancer appear to be the lung and the prostate (L-140-50). Evidence for an association between cancer and cadmium exposure derives from both epidemiological studies and animal experiments. Mortality from prostate cancer associated with cadmium is slightly elevated in several industrial cohorts, but the number of cases is small and there is not clear dose-response relationship. More substantive evidence exists for lung cancer. The major epidemiological study of lung cancer was conducted by Thun et al., (Ex. 4-68). Adequate data on cadmium exposures were available to allow evaluation of dose-response relationships between cadmium exposure and lung cancer. A statistically significant excess of lung cancer attributed to cadmium exposure was observed in this study even when confounding variables such as co-exposure to arsenic and smoking habits were taken into consideration (Ex. L-140-50). The primary evidence for quantifying a link between lung cancer and cadmium exposure from animal studies derives from two rat bioassay studies; one by Takenaka et al., (1983), which is a study of cadmium chloride and a second study by Oldiges and Glaser (1990) of four cadmium compounds. Based on the above cited studies, the U.S. Environmental Protection Agency (EPA) classified cadmium as "B1", a probable human carcinogen, in 1985 (Ex. 4-4). The International Agency for Research on Cancer (IARC) in 1987 also recommended that cadmium be listed as "2A", a probable human carcinogen (Ex. 4-15). The American Conference of Governmental Industrial Hygienists (ACGIH) has recently recommended that cadmium be labeled as a carcinogen. Since 1984, NIOSH has concluded that cadmium is possibly a human carcinogen and has recommended that exposures be controlled to the lowest level feasible.

(iv) Noncarcinogenic effects. Acute pneumonitis occurs 10 to 24 hours after initial acute inhalation of high levels of cadmium fumes with symptoms such as fever and chest pain (Exs. 30, 8-86B). In extreme exposure cases pulmonary edema may develop and cause death several days after exposure. Little actual exposure measurement data is available on the level of airborne cadmium exposure that causes such immediate adverse lung effects, nonetheless, it is reasonable to believe cadmium concentration of approximately 1 mg/m3 over an eight hour period is "immediately dangerous" (55 FR 4052, ANSI; Ex. 8-86B). In addition to acute lung effects and chronic renal effects, long term exposure to cadmium may cause other severe effects on the respiratory system. Reduced pulmonary function and chronic lung disease indicative of emphysema have been observed in workers who have had prolonged exposure to cadmium dust or fumes (Exs. 4-29, 4-22, 4-42, 4-50, 4-63). In a study of workers conducted by Kazantzis et al., a statistically significant excess of worker deaths due to chronic bronchitis was found, which in his opinion was directly related to high cadmium exposures of 1 mg/m3 or more (Tr. 6/8/90, pp. 156-157). Cadmium need not be respirable to constitute a hazard. Inspirable cadmium particles that are too large to be respirable but small enough to enter the tracheobronchial region of the lung can lead to bronchoconstriction, chronic pulmonary disease, and cancer of that portion of the lung. All of these diseases have been associated with occupational exposure to cadmium (Ex. 8- 86B). Particles that are constrained by their size to the extra-thoracic regions of the respiratory system such as the nose and maxillary sinuses can be swallowed through mucocillary clearance and be absorbed into the body (ACGIH, Ex. 8-692). The impaction of these particles in the upper airways can lead to anosmia, or loss of sense of smell, which is an early indication of overexposure among workers exposed to heavy metals. This condition is commonly reported among cadmium-exposed workers (Ex. 8-86-B).

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(c) Medical surveillance. In general, the main provisions of the medical surveillance section of the standard, under WAC 296-62-07423 (1) through (16), are as follows:

(i) Workers exposed above the action level are covered;

(ii) Workers with intermittent exposures are not covered;

(iii) Past workers who are covered receive biological monitoring for at least one year;

(iv) Initial examinations include a medical questionnaire and biological monitoring of cadmium in blood (CdB), cadmium in urine (CdU), and Beta-2-microglobulin in urine (ß2-M);

(v) Biological monitoring of these three analytes is performed at least annually; full medical examinations are performed biennially;

(vi) Until five years from the effective date of the standard, medical removal is required when CdU is greater than 15 µg/gram creatinine (g Cr), or CdB is greater than 15 µg/liter whole blood (lwb), or ß2-M is greater than 1500 µg/g Cr, and CdB is greater than 5 µg/lwb or CdU is greater than 3 µg/g Cr;

(vii) Beginning five years after the standard is in effect, medical removal triggers will be reduced;

(viii) Medical removal protection benefits are to be provided for up to eighteen months;

(ix) Limited initial medical examinations are required for respirator usage;

(x) Major provisions are fully described under WAC 296-62-07423; they are outlined here as follows:

(A) Eligibility.

(B) Biological monitoring.

(C) Actions triggered by levels of CdU, CdB, and ß2-M (See Summary Charts and Tables in WAC 296-62-07441(5).)

(D) Periodic medical surveillance.

(E) Actions triggered by periodic medical surveillance (See appendix A Summary Chart and Tables in WAC 296-62-07441(5).)

(F) Respirator usage.

(G) Emergency medical examinations.

(H) Termination examination.

(I) Information to physician.

(J) Physician's medical opinion.

(K) Medical removal protection.

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(L) Medical removal protection benefits.

(M) Multiple physician review.

(N) Alternate physician review.

(O) Information employer gives to employee.

(P) Recordkeeping.

(Q) Reporting on OSHA form 200.

(xi) The above mentioned summary of the medical surveillance provisions, the summary chart, and tables for the actions triggered at different levels of CdU, CdB and ß2-M (in subsection (5) of this section, Attachment 1) are included only for the purpose of facilitating understanding of the provisions of WAC 296-62-07423(3) of the final cadmium standard. The summary of the provisions, the summary chart, and the tables do not add to or reduce the requirements in WAC 296-62-07423(3).

(d) Recommendations to physicians.

(i) It is strongly recommended that patients with tubular proteinuria are counseled on: The hazards of smoking; avoidance of nephrotoxins and certain prescriptions and over-the-counter medications that may exacerbate kidney symptoms; how to control diabetes and/or blood pressure; proper hydration, diet, and exercise (Ex. 19-2). A list of prominent or common nephrotoxins is attached. (See subsection (6) of this section, Attachment 2.)

(ii) DO NOT CHELATE; KNOW WHICH DRUGS ARE NEPHROTOXINS OR ARE ASSOCIATED WITH NEPHRITIS.

(iii) The gravity of cadmium-induced renal damage is compounded by the fact there is no medical treatment to prevent or reduce the accumulation of cadmium in the kidney (Ex. 8-619). Dr. Friberg, a leading world expert on cadmium toxicity, indicated in 1992, that there is no form of chelating agent that could be used without substantial risk. He stated that tubular proteinuria has to be treated in the same way as other kidney disorders (Ex. 29).

(iv) After the results of a workers' biological monitoring or medical examination are received the employer is required to provide an information sheet to the patient, briefly explaining the significance of the results. (See subsection (7) of this section.)

(v) For additional information the physician is referred to the following additional resources:

(A) The physician can always obtain a copy of the OSHA final rule preamble, with its full discussion of the health effects, from OSHA's Computerized Information System (OCIS).

(B) The OSHA Docket Officer maintains a record of the OSHA rulemaking. The Cadmium Docket (H-057A), is located at 200 Constitution Ave. NW., Room N-2625, Washington, DC 20210; telephone: (202) 219-7894.

(C) The following articles and exhibits in particular from that docket (H- 057A):

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Exhibit number	Author and paper title
8-447	Lauwerys et. al., Guide for physicians, "Health Maintenance of Workers Exposed to Cadmium," published by the Cadmium Council.
4-67	Takenaka, S., H. Oldiges, H. Konig, D. Hochrainer, G. Oberdorster. "Carcinogenicity of Cadmium Chloride Aerosols in Wistar Rats". JNCI 70:367-373, 1983. (32)
4-68	Thun, M.J., T.M. Schnoor, A.B. Smith, W.E. Halperin, R.A. Lemen. "Mortality Among a Cohort of U.S. Cadmium Production Workers--An Update." JNCI 74(2):325-33, 1985. (8)
4-25	Elinder, C.G., Kjellstrom, T., Hogstedt, C., et al., "Cancer Mortality of Cadmium Workers." Brit. J. Ind. Med. 42:651-655, 1985. (14)
4-26	Ellis, K.J. et al., "Critical Concentrations of Cadmium in Human Renal Cortex: Dose Effect Studies to Cadmium Smelter Workers." J. Toxicol. Environ. Health 7:691-703, 1981. (76)
4-27	Ellis, K.J., S.H. Cohn and T.J. Smith. "Cadmium Inhalation Exposure Estimates: Their Significance with Respect to Kidney and Liver Cadmium Burden." J. Toxicol. Environ. Health 15:173-187, 1985.
4-28	Falck, F.Y., Jr., Fine, L.J., Smith, R.G., McClatchey, K.D., Annesley, T., England, B., and Schork, A.M. "Occupational Cadmium Exposure and Renal Status." Am. J. Ind. Med. 4:541, 1983. (64)
8-86A	Friberg, L., C.G. Elinder, et al., "Cadmium and Health a Toxicological and Epidemiological Appraisal, Volume I, Exposure, Dose, and Metabolism." CRC Press, Inc., Boca Raton, FL, 1986. (Available from the OSHA Technical Data Center)
8-86B	Friberg, L., C.G. Elinder, et al., "Cadmium and Health: A Toxicological and Epidemiological Appraisal, Volume II, Effects and Response." CRC Press, Inc., Boca Raton, FL, 1986. (Available from the OSHA Technical Data Center)
L-140-45	Elinder, C.G., "Cancer Mortality of Cadmium Workers", Brit. J. Ind. Med., 42, 651-655, 1985.
L-140-50	Thun, M., Elinder, C.G., Friberg, L, "Scientific Basis for an Occupational Standard for Cadmium, Am. J. Ind. Med., 20; 629-642, 1991.

(5) **Information sheet.** The information sheet (subsection (8) of this section, Attachment 3) or an equally explanatory one should be provided to you after any biological monitoring results are reviewed by the physician, or where applicable, after any medical examination.

(6) **Attachment 1--Appendix A,** summary chart and Tables A and B of actions triggered by biological monitoring.

(a) Summary chart: WAC 296-62-07423(3) Medical surveillance--Categorizing biological monitoring results.

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(i) Biological monitoring results categories are set forth in Table A for the periods ending December 31, 1998, and for the period beginning January 1, 1999.

(ii) The results of the biological monitoring for the initial medical exam and the subsequent exams shall determine an employee's biological monitoring result category.

(b) Actions triggered by biological monitoring.

(i) The actions triggered by biological monitoring for an employee are set forth in Table B.

(ii) The biological monitoring results for each employee under WAC 296-62-07423(3) shall determine the actions required for that employee. That is, for any employee in biological monitoring category C, the employer will perform all of the actions for which there is an X in column C of Table B.

(iii) An employee is assigned the alphabetical category ("A" being the lowest) depending upon the test results of the three biological markers.

(iv) An employee is assigned category A if monitoring results for all three biological markers fall at or below the levels indicated in the table listed for category A.

(v) An employee is assigned category B if any monitoring result for any of the three biological markers fall within the range of levels indicated in the table listed for category B, providing no result exceeds the levels listed for category B.

(vi) An employee is assigned category C if any monitoring result for any of the three biological markers are above the levels listed for category C.

(c) The user of Tables A and B should know that these tables are provided only to facilitate understanding of the relevant provisions of WAC 296-62-07423. Tables A and B are not meant to add to or subtract from the requirements of those provisions.

Table A
Categorization of Biological Monitoring Results
Applicable Through 1998 Only

	Monitoring result categories		
Biological marker	**A**	**B**	**C**
Cadmium in urine (CdU) (µg/g creatinine)	≤ = 3	>3 and ≤ = 15	>15
ß2-microglobulin (ß2-M) (µg/g creatinine)	≤ = 300	>300 and ≤ = 1500	>1500*
Cadmium in blood (CdB) (µg/liter whole blood)	≤ = 5	>5 and ≤ = 15	>15

* If an employee's ß2-M levels are above 1,500 µg/g creatinine, in order for mandatory medical removal to be required (See WAC 296-62-07441, Appendix A Table B.), either the employee's CdU level must also be >3 µg/g creatinine or CdB level must also be >5 µg/liter whole blood.

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Applicable Beginning January 1, 1999

Monitoring result categories

Biological marker	A	B	C
Cadmium in urine (CdU) (µg/g creatinine)	≤ = 3	>3 and ≤ = 7	>7
ß2-microglobulin (ß2-M) (µg/g creatinine)	≤ = 300	>300 and ≤ = 750	>750*
Cadmium in blood (CdB) (µg/liter whole blood)	≤ = 5	>5 and ≤ = 10	>10

* If an employee's ß2-M levels are above 750 µg/g creatinine, in order for mandatory medical removal to be required (See WAC 296-62-07441, Appendix A Table B.), either the employee's CdU level must also be >3 µg/g creatinine or CdB level must also be >5 µg/liter whole blood.

Table B--Actions determined by biological monitoring.

This table presents the actions required based on the monitoring result in Table A. Each item is a separate requirement in citing noncompliance. For example, a medical examination within ninety days for an employee in category B is separate from the requirement to administer a periodic medical examination for category B employees on an annual basis.

Table B

	Monitoring result category		
	A[1]	B[1]	C[1]
Required actions			
(1) Biological monitoring:			
(a) Annual.	X		
(b) Semiannual.		X	
(c) Quarterly.			X
(2) Medical examination:			
(a) Biennial.	X		
(b) Annual.		X	
(c) Semiannual.			X
(d) Within 90 days.		X	X
(3) Assess within two weeks:			
(a) Excess cadmium exposure.		X	X
(b) Work-practices.		X	X
(c) Personal hygiene.		X	X
(d) Respirator usage.		X	X
(e) Smoking history.		X	X
(f) Hygiene facilities.		X	X
(g) Engineering controls.		X	X
(h) Correct within 30 days.		X	X
(i) Periodically assess exposures.			X
(4) Discretionary medical removal.		X	X
(5) Mandatory medical removal.			X[2]

[1] For all employees covered by medical surveillance exclusively because of exposures prior to the effective date of this standard, if they are in Category A, the employer shall follow the requirements of WAC 296-62-07423 (3)(a)(ii)

and (4)(e)(i). If they are in Category B or C, the employer shall follow the requirements of WAC 296-62-07423 (4)(e)(ii) and (iii).

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[2] See footnote in Table A.

(7) **Attachment 2, list of medications.**

(a) A list of the more common medications that a physician, and the employee, may wish to review is likely to include some of the following:

(i) Anticonvulsants: Paramethadione, phenytoin, trimethadone;

(ii) Antihypertensive drugs: Captopril, methyldopa;

(iii) Antimicrobials: Aminoglycosides, amphotericin B, cephalosporins, ethambutol;

(iv) Antineoplastic agents: Cisplatin, methotrexate, mitomycin-C, nitrosoureas, radiation;

(v) Sulfonamide diuretics: Acetazolamide, chlorthalidone, furosemide, thiazides;

(vi) Halogenated alkanes, hydrocarbons, and solvents that may occur in some settings: Carbon tetrachloride, ethylene glycol, toluene; iodinated radiographic contrast media; nonsteroidal anti-inflammatory drugs; and

(vii) Other miscellaneous compounds: Acetaminophen, allopurinol, amphetamines, azathioprine, cimetidine, cyclosporine, lithium, methoxyflurane, methysergide, D-penicillamine, phenacetin, phenendione.

(b) A list of drugs associated with acute interstitial nephritis includes:

(i) Antimicrobial drugs: Cephalosporins, chloramphenicol, colistin, erythromycin, ethambutol, isoniazid, para-aminosalicylic acid, penicillins, polymyxin B, rifampin, sulfonamides, tetracyclines, and vancomycin;

(ii) Other miscellaneous drugs: Allopurinol, antipyrine, azathioprine, captopril, cimetidine, clofibrate, methyldopa, phenindione, phenylpropanolamine, phenytoin, probenecid, sulfinpyrazone, sulfonamide diuretics, triamterene; and

(iii) Metals: Bismuth, gold. This list has been derived from commonly available medical textbooks (e.g., Ex. 14-18). The list has been included merely to facilitate the physician's, employer's, and employee's understanding. The list does not represent an official OSHA opinion or policy regarding the use of these medications for particular employees. The use of such medications should be under physician discretion.

(8) **Attachment 3--Biological monitoring and medical examination results.**

Employee_____

Testing Date_____

Cadmium in Urine ___ µg/g Cr--Normal Levels: ≤ = 3 µg/g Cr.

Cadmium in Blood ___ µg/lwb--Normal Levels: ≤ = 5 µg/lwb.

Beta-2-microglobulin in Urine ___ µg/g Cr—Normal Levels: ≤ = 300 µg/g Cr.

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Physical Examination Results: N/A ___ Satisfactory ___ Unsatisfactory ___ (see physician again).

Physician's Review of Pulmonary Function Test: N/A ___ Normal ___ Abnormal ___.

Next biological monitoring or medical examination scheduled for _____.

(a) The biological monitoring program has been designed for three main purposes:

(i) To identify employees at risk of adverse health effects from excess, chronic exposure to cadmium;

(ii) To prevent cadmium-induced disease(s); and

(iii) To detect and minimize existing cadmium-induced disease(s).

(b) The levels of cadmium in the urine and blood provide an estimate of the total amount of cadmium in the body. The amount of a specific protein in the urine (beta-2-microglobulin) indicates changes in kidney function. All three tests must be evaluated together. A single mildly elevated result may not be important if testing at a later time indicates that the results are normal and the workplace has been evaluated to decrease possible sources of cadmium exposure. The levels of cadmium or beta-2-microglobulin may change over a period of days to months and the time needed for those changes to occur is different for each worker.

(c) If the results for biological monitoring are above specific “high levels” (cadmium urine greater than 10 micrograms per gram of creatinine µg/ Cr), cadmium blood greater than 10 micrograms per liter of whole blood (µg/lwb), or beta-2-microglobulin greater than 1000 micrograms per gram of creatinine (µg/g Cr), the worker has a much greater chance of developing other kidney diseases.

(d) One way to measure for kidney function is by measuring beta-2-microglobulin in the urine. Beta-2-microglobulin is a protein which is normally found in the blood as it is being filtered in the kidney, and the kidney reabsorbs or returns almost all of the beta-2-microglobulin to the blood. A very small amount (less than 300 µg/g Cr in the urine) of beta-2-microglobulin is not reabsorbed into the blood, but is released in the urine. If cadmium damages the kidney, the amount of beta-2-microglobulin in the urine increases because the kidney cells are unable to reabsorb the beta-2-microglobulin normally. An increase in the amount of beta-2-microglobulin in the urine is a very early sign of kidney dysfunction. A small increase in beta-2-microglobulin in the urine will serve as an early warning sign that the worker may be absorbing cadmium from the air, cigarettes contaminated in the workplace, or eating in areas that are cadmium contaminated.

(e) Even if cadmium causes permanent changes in the kidney's ability to reabsorb beta-2-microglobulin, and the beta-2-microglobulin is above the “high levels,” the loss of kidney function may not lead to any serious health problems. Also, renal function naturally declines as people age. The risk for changes in kidney function for workers who have biological monitoring results between the “normal values” and the “high levels” is not well known. Some people are more cadmium-tolerant, while others are more cadmium-susceptible.

(f) For anyone with even a slight increase of beta-2-microglobulin, cadmium in the urine, or cadmium in the blood, it is very important to protect the kidney from further damage. Kidney damage can come from other sources than excess cadmium-exposure so it is also recommended that if a worker's levels are “high” he/she should receive counseling about drinking more water; avoiding cadmium-tainted tobacco and certain medications (nephrotoxins, acetaminophen); controlling diet, vitamin intake, blood pressure and diabetes; etc.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07271, filed 05/04/99, effective 09/01/99.]
[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), § 296-62-07441, filed 7/20/94, effective 9/20/94; 93-21-075 (Order 93-06), § 296-62-07441, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07441, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07443 Appendix B--Substance technical guidelines for cadmium.

(1) **Cadmium metal.**

(a) Physical and chemical data.

(i) Substance identification.

Chemical name: Cadmium.

Formula: Cd.

Molecular Weight: 112.4.

Chemical Abstracts Service (CAS) Registry No.: 7740-43-9.

Other identifiers: RETCS EU9800000; EPA D006; DOT 2570 53.

Synonyms: Colloidal Cadmium: Kadmium (German): CI 77180.

(ii) Physical data.

Boiling point: (760 mm Hg): 765 degrees C.

Melting point: 321 degrees C.

Specific gravity: (H_2O = @ 20°C): 8.64.

Solubility: Insoluble in water; soluble in dilute nitric acid and in sulfuric acid.

Appearance: Soft, blue-white, malleable, lustrous metal or grayish-white powder.

(b) Fire, explosion, and reactivity data.

(i) Fire.

Fire and explosion hazards: The finely divided metal is pyrophoric, that is the dust is a severe fire hazard and moderate explosion hazard when exposed to heat or flame. Burning material reacts violently with extinguishing agents such as water, foam, carbon dioxide, and halons.

Flash point: Flammable (dust).

Extinguishing media: Dry sand, dry dolomite, dry graphite, or sodium chloride.

(ii) Reactivity.

Conditions contributing to instability: Stable when kept in sealed containers under normal temperatures and pressure, but dust may ignite upon contact with air. Metal tarnishes in moist air.

(iii) Incompatibilities: Ammonium nitrate, fused: Reacts violently or explosively with cadmium dust below 20°C. Hydrozoic acid: Violent explosion occurs after thirty minutes. Acids: Reacts violently, forms hydrogen gas. Oxidizing agents or metals:

Strong reaction with cadmium dust. Nitryl fluoride at slightly elevated temperature: Glowing or white incandescence occurs. Selenium: Reacts exothermically. Ammonia: Corrosive reaction. Sulfur dioxide: Corrosive reaction. Fire extinguishing agents (water, foam, carbon dioxide, and halons): Reacts violently. Tellurium: Incandescent reaction in hydrogen atmosphere.

(iv) Hazardous decomposition products: The heated metal rapidly forms highly toxic, brownish fumes of oxides of cadmium.

(c) Spill, leak, and disposal procedures.

(i) Steps to be taken if the materials is released or spilled. Do not touch spilled material. Stop leak if you can do it without risk. Do not get water inside container. For large spills, dike spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

(ii) The Superfund Amendments and Reauthorization Act of 1986 Section 304 requires that a release equal to or greater than the reportable quantity for this substance (one pound) must be immediately reported to the local emergency planning committee, the state emergency response commission, and the National Response Center (800) 424-8802; in Washington, DC metropolitan area (202) 426-2675.

(2) **Cadmium oxide.**

(a) Physical and chemical date.

(i) Substance identification.

Chemical name: Cadmium oxide.

Formula: CdO.

Molecular Weight: 128.4.

CAS No.: 1306-19-0.

Other identifiers: RTECS EV1929500.

Synonyms: Kadmu tlenek (Polish).

(ii) Physical data.

Boiling point (760 mm Hg): 950 degrees C decomposes.

Melting point: 1500°C.

Specific gravity: (H_2O = 1@20°C): 7.0.

Solubility: Insoluble in water; soluble in acids and alkalines.

Appearance: Red or brown crystals.

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(b) Fire, explosion, and reactivity data.

(i) Fire.

Fire and explosion hazards: Negligible fire hazard when exposed to heat or flame.

Flash point: Nonflammable.

Extinguishing media: Dry chemical, carbon dioxide, water spray or foam.

(ii) Reactivity.

Conditions contributing to instability: Stable under normal temperatures and pressures.

(iii) Incompatibilities: Magnesium may reduce CdO2 explosively on heating.

(iv) Hazardous decomposition products: Toxic fumes of cadmium.

(c) Spill, leak, and disposal procedures.

(i) Steps to be taken if the material is released or spilled. Do not touch spilled material. Stop leak if you can do it without risk. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For small dry spills, use a clean shovel to place material into clean, dry container and then cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

(ii) The Superfund Amendments and Reauthorization Act of 1986 Section 304 requires that a release equal to or greater than the reportable quantity for this substance (one pound) must be immediately reported to the local emergency planning committee, the state emergency response commission, and the National Response Center (800) 424-8802; in Washington, DC metropolitan area (202) 426-2675.

(3) **Cadmium sulfide.**

(a) Physical and chemical data.

(i) Substance identification.

Chemical name: Cadmium sulfide.

Formula: CdS.

Molecular weight: 144.5.

CAS No. 1306-23-6.

Other identifiers: RTECS EV3150000.

Synonyms: Aurora yellow; Cadmium Golden 366; Cadmium Lemon Yellow 527; Cadmium Orange; Cadmium Primrose 819; Cadmium Sulphide; Cadmium Yellow; Cadmium Yellow 000; Cadmium Yellow Conc. Deep; Cadmium Yellow Conc.

Golden; Cadmium Yellow Conc. Lemon; Cadmium Yellow Conc. Primrose; Cadmium Yellow Oz. Dark; Cadmium Yellow Primrose 47-1400; Cadmium Yellow 10G Conc.; Cadmium Yellow 892; Cadmopur Golden Yellow N; Cadmopur Yellow: Capsebon; C.I. 77199; C.I. Pigment Orange 20; CI Pigment Yellow 37; Ferro Lemon Yellow; Ferro Orange Yellow; Ferro Yellow; Greenockite; NCI-C02711.

(ii) Physical data.

Boiling point (760 mm. Hg): sublines in N2 at 980°C.

Melting point: 1750 degrees C (100 atm).

Specific gravity: (H_2O = 1@ 20°C): 4.82.

Solubility: Slightly soluble in water; soluble in acid.

Appearance: Light yellow or yellow-orange crystals.

(b) Fire, explosion, and reactivity data.

(i) Fire.

Fire and explosion hazards: Negligible fire hazard when exposed to heat or flame.

Flash point: Nonflammable.

Extinguishing media: Dry chemical, carbon dioxide, water spray or foam.

(ii) Reactivity. Conditions contributing to instability: Generally nonreactive under normal conditions. Reacts with acids to form toxic hydrogen sulfide gas.

(iii) Incompatibilities: Reacts vigorously with iodinemonochloride.

(iv) Hazardous decomposition products: Toxic fumes of cadmium and sulfur oxides.

(c) Spill, leak, and disposal procedures.

(i) Steps to be taken if the material is released or spilled. Do not touch spilled material. Stop leak if you can do it without risk. For small, dry spills, with a clean shovel place material into clean, dry container and cover. Move containers from spill area.

(ii) For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard and deny entry.

(4) **Cadmium chloride.**

(a) Physical and chemical data.

(i) Substance identification.

Chemical name: Cadmium chloride.

Formula: CdC12.

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Molecular weight: 183.3.

CAS No. 10108-64-2.

Other identifiers: RTECS EY0175000.

Synonyms: Caddy; Cadmium dichloride; NA 2570 (DOT); UI-CAD; dichlorocadmium.

(ii) Physical data.

Boiling point (760 mm Hg): 960 degrees C.

Melting point: 568 degrees C.

Specific gravity: (H_2O = 1 @ 20°C): 4.05.

Solubility: Soluble in water (140 g/100 cc); soluble in acetone.

Appearance: Small, white crystals.

(b) Fire, explosion, and reactivity data.

(i) Fire.

Fire and explosion hazards: Negligible fire and negligible explosion hazard in dust form when exposed to heat or flame.

Flash point: Nonflammable.

Extinguishing media: Dry chemical, carbon dioxide, water spray, or foam.

(ii) Reactivity. Conditions contributing to instability: Generally stable under normal temperatures and pressures.

(iii) Incompatibilities: Bromine triflouride [trifluoride] rapidly attacks cadmium chloride. A mixture of potassium and cadmium chloride may produce a strong explosion on impact.

(iv) Hazardous decomposition products: Thermal decomposition may release toxic fumes of hydrogen chloride, chloride, chlorine or oxides of cadmium.

(c) Spill, leak, and disposal procedures.

(i) Steps to be taken if the materials is released or spilled. Do not touch spilled material. Stop leak if you can do it without risk. For small, dry spills, with a clean shovel place material into clean, dry container and cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard and deny entry.

(ii) The Superfund Amendments and Reauthorization Act of 1986 Section 304 requires that a release equal to or greater than the reportable quantity for this substance (one hundred pounds) must be immediately reported to the local emergency planning committee, the state emergency response commission, and the National Response Center (800) 424-8802; in Washington, DC Metropolitan area (202) 426-2675.

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07443, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07447 Appendix D--Occupational health history interview with reference to cadmium exposure directions.

(To be read by employee and signed prior to the interview.)

Please answer the questions you will be asked as completely and carefully as you can. These questions are asked of everyone who works with cadmium. You will also be asked to give blood and urine samples. The doctor will give your employer a written opinion on whether you are physically capable of working with cadmium. Legally, the doctor cannot share personal information you may tell him/her with your employer. The following information is considered strictly confidential. The results of the tests will go to you, your doctor and your employer. You will also receive an information sheet explaining the results of any biological monitoring or physical examinations performed. If you are just being hired, the results of this interview and examination will be used to:

(1) Establish your health status and see if working with cadmium might be expected to cause unusual problems;

(2) Determine your health status today and see if there are changes over time;

(3) See if you can wear a respirator safely. If you are not a new hire: WISHA says that everyone who works with cadmium can have periodic medical examinations performed by a doctor. The reasons for this are:

(a) If there are changes in your health, either because of cadmium or some other reason, to find them early;

(b) To prevent kidney damage.

Please sign below.
I have read these directions and understand them:

_____
Employee signature

_____
Date

Thank you for answering these questions. (Suggested Format)
Name:_____
Age:_____
Social Security #:_____
Company:_____Job:_____
Type of Preplacement Exam: [ ] Periodic [ ] Termination [ ] Initial [ ] Other
Blood Pressure:_____Pulse Rate:_____

1. How long have you worked at the job listed above?
   [ ] Not yet hired [ ] Number of months [ ] Number of years
2. Job Duties etc._____
   _____
3. Have you ever been told by a doctor that you had bronchitis? [ ] Yes [ ] No
   If yes, how long ago? [ ] Number of months [ ] Number of years
4. Have you ever been told by a doctor that you had emphysema? [ ] Yes [ ] No
   If yes, how long ago? [ ] Number of years [ ] Number of months
5. Have you ever been told by a doctor that you had other lung problems? [ ] Yes [ ] No
   If yes, please describe type of lung problems and when you had these problems: _____
   _____
   _____
6. In the past year, have you had a cough? [ ] Yes [ ] No
   If yes, did you cough up sputum? [ ] Yes [ ] No
   If yes, how long did the cough with sputum production last? [ ] Less than 3 months [ ] 3 months or longer
   If yes, for how many years have you had episodes of cough with sputum production lasting this long? [ ] Less than one [ ] 1 [ ] 2 [ ] Longer than 2

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7. Have you ever smoked cigarettes? [ ] Yes [ ] No
8. Do you now smoke cigarettes? [ ] Yes [ ] No
9. If you smoke or have smoked cigarettes, for how many years have you smoked, or did you smoke?
   [ ] Less than 1 year [ ] Number of years
   What is or was the greatest number of packs per day that you have smoked? [ ] Number of packs
   If you quit smoking cigarettes, how many years ago did you quit?
   [ ] Less than 1 year [ ] Number of years
   How many packs a day do you now smoke? [ ] Number of packs per day
10. Have you ever been told by a doctor that you had a kidney or urinary tract disease or disorder?
    [ ] Yes [ ] No
11. Have you ever had any of these disorders?

Kidney stones	[ ] Yes [ ] No
Protein in urine	[ ] Yes [ ] No
Blood in urine	[ ] Yes [ ] No
Difficulty urinating	[ ] Yes [ ] No
Other kidney/Urinary disorders	[ ] Yes [ ] No

Please describe problems, age, treatment, and follow up for any kidney or urinary problems you have had:
_____
_____
_____

12. Have you ever been told by a doctor or other health care provider who took your blood pressure that your blood pressure was high? [ ] Yes [ ] No
13 Have you ever been advised to take any blood pressure medication? [ ] Yes [ ] No
14. Are you presently taking any blood pressure medication? [ ] Yes [ ] No
15. Are you presently taking any other medication? [ ] Yes [ ] No
16. Please list any blood pressure or other medications and describe how long you have been taking each one:
    Medicine:_____
    _____
    _____
    How Long Taken:_____
17. Have you ever been told by a doctor that you have diabetes? (sugar in your blood or urine)
    [ ] Yes [ ] No
    If yes, do you presently see a doctor about your diabetes? [ ] Yes [ ] No
    If yes, how do you control your blood sugar? [ ] Diet alone [ ] Diet
    plus oral medicine [ ] Diet plus insulin (injection)
18. Have you ever been told by a doctor that you had:
    Anemia ? [ ] Yes [ ] No
    A low blood count? [ ] Yes [ ] No
19. Do you presently feel that you tire or run out of energy sooner than normal or sooner than other people your age? [ ] Yes [ ] No
    If yes, for how long have you felt that you tire easily? [ ] Less than 1 year [ ] Number of years
20. Have you given blood within the last year? [ ] Yes [ ] No
    If yes, how many times? [ ] Number of times
    How long ago was the last time you gave blood? [ ] Less than 1 month [ ] Number of months
21. Within the last year have you had any injuries with heavy bleeding? [ ] Yes [ ] No
    If yes, how long ago? [ ] Less than 1 month [ ] Number of months describe:
22. Have you recently had any surgery? [ ] Yes [ ] No If yes, please describe:_____
    _____
    _____
23. Have you seen any blood lately in your stool or after a bowel movement? [ ] Yes [ ] No

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24. Have you ever had a test for blood in your stool? [ ] Yes [ ] No
If yes, did the test show any blood in the stool? [ ] Yes [ ] No
What further evaluation and treatment were done?_____
_____
_____

The following questions pertain to the ability to wear a respirator. Additional information for the physician can be found in The Respiratory Protective Devices Manual.

25. Have you ever been told by a doctor that you have asthma? [ ] Yes [ ] No
If yes, are you presently taking any medication for asthma?
Mark all that apply. [ ] Shots [ ] Pills [ ] Inhaler
26. Have you ever had a heart attack? [ ] Yes [ ] No
If yes, how long ago? [ ] Number of years [ ] Number of months
27. Have you ever had pains in your chest? [ ] Yes [ ] No
If yes, when did it usually happen?
[ ] While resting [ ] While working [ ] While exercising [ ] Activity didn't matter
28. Have you ever had a thyroid problem? [ ] Yes [ ] No
29. Have you ever had a seizure or fits? [ ] Yes [ ] No
30. Have you ever had a stroke (cerebrovascular accident)? [ ] Yes [ ] No
31. Have you ever had a ruptured eardrum or a serious hearing problem? [ ] Yes [ ] No
32. Do you now have a claustrophobia, meaning fear of crowded or closed in spaces or any psychological problems that would make it hard for you to wear a respirator? [ ] Yes [ ] No

The following questions pertain to reproductive history.

33. Have you or your partner had a problem conceiving a child? [ ] Yes [ ] No
If yes, specify: [ ] Self [ ] Present mate [ ] Previous mate
34. Have you or your partner consulted a physician for a fertility or other reproductive problem?
[ ] Yes [ ] No
If yes, specify who consulted the physician: [ ] Self [ ] Spouse/partner [ ] Self and partner
If yes, specify diagnosis made:_____
_____
35. Have you or your partner ever conceived a child resulting in a miscarriage, still birth or deformed offspring? [ ] Yes [ ] No
If yes, specify: [ ] Miscarriage [ ] Still birth [ ] Deformed offspring
If outcome was a deformed offspring, please specify
type:_____
_____
_____
36. Was this outcome a result of a pregnancy of: [ ] Yours with present partner [ ] Yours with a previous partner
37. Did the timing of any abnormal pregnancy outcome coincide with present employment?
[ ] Yes [ ] No List dates of
occurrences:_____
_____
_____
38. What is the occupation of your spouse or partner?
_____
_____
_____

For Women Only

39. Do you have menstrual periods? [ ] Yes [ ] No
Have you had menstrual irregularities? [ ] Yes [ ] No
If yes, specify type:_____
If yes, what was the approximated date this problem began?_____
Approximate date problem stopped?_____

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For Men Only

40. Have you ever been diagnosed by a physician as having prostate gland problem(s)? [ ] Yes [ ] No
If yes, please describe type of problem(s) and what was done to evaluate and treat the problem(s):
_____
_____

[Statutory Authority: Chapter 49.17 RCW. 93-21-075 (Order 93-06), § 296-62-07447, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07447, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07449 Appendix E--Cadmium in workplace atmospheres.

Method number: ID-189 (OSHA); (ICP/MS) 0009 (WISHA)

Matrix: Air

WISHA permissible exposure limits: 5 µg/m^3 (TWA), 2.5 µg/m^3 (action level TWA)

Collection procedure: A known volume of air is drawn through a 37-mm diameter filter cassette containing a 0.8 µm mixed cellulose ester membrane filter (MCEF).

Recommended air volume: 960 L

Recommended sampling rate: 2.0 L/min

Analytical procedure: Air filter samples are digested with nitric acid. After digestion, a small amount of hydrochloric acid is added. The samples are then diluted to volume with deionized water and analyzed by either flame atomic absorption spectroscopy (AAS) or flameless atomic absorption spectroscopy using a heated graphite furnace atomizer (AAS-HGA).

Detection limits:

Qualitative: 0.2 µg/m^3 for a 200 L sample by Flame AAS, 0.007 µg/m^3 for a 60 L sample by AAS-HGA

Quantitative: 0.70 µg/m^3 for a 200 L sample by Flame AAS, 0.025 µg/m^3 for a 60 L sample by AAS-HGA

Precision and accuracy: (Flame AAS Analysis and AAS-HGA Analysis):

Validation level: 2.5 to 10 µg/m^3 for a 400 L air vol, 1.25 to 5.0 µg/m^3 for a 60 L air vol CV_1 (pooled): 0.010, 0.043

Analytical bias: +4.0%, -5.8%

Overall analytical error: ±6.0%, ±14.2%

Method classification: Validated Date: June, 1992

Inorganic Service Branch II, OSHA Salt Lake Technical Center, Salt Lake City, Utah Commercial manufacturers and products mentioned in this method are for descriptive use only and do not constitute endorsements by USDOL-OSHA. Similar products from other sources can be substituted.

(1) **Introduction.**

(a) Scope.

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This method describes the collection of airborne elemental cadmium and cadmium compounds on 0.8 µm mixed cellulose ester membrane filters and their subsequent analysis by either flame atomic absorption spectroscopy (AAS) or flameless atomic absorption spectroscopy using a heated graphite furnace atomizer (AAS-HGA). It is applicable for both TWA and action level TWA permissible exposure level (PEL) measurements. The two atomic absorption analytical techniques included in the method do not differentiate between cadmium fume and cadmium dust samples. They also do not differentiate between elemental cadmium and its compounds.

(b) Principle.

Airborne elemental cadmium and cadmium compounds are collected on a 0.8 µm mixed cellulose ester membrane filter (MCEF). The air filter samples are digested with concentrated nitric acid to destroy the organic matrix and dissolve the cadmium analytes. After digestion, a small amount of concentrated hydrochloric acid is added to help dissolve other metals which may be present. The samples are diluted to volume with deionized water and then aspirated into the oxidizing air/acetylene flame of an atomic absorption spectrophotometer for analysis of elemental cadmium. If the concentration of cadmium in a sample solution is too low for quantitation by this flame AAS analytical technique, and the sample is to be averaged with other samples for TWA calculations, aliquots of the sample and a matrix modifier are later injected onto a L'vov platform in a pyrolytically-coated graphite tube of a Zeeman atomic absorption spectrophotometer/graphite furnace assembly for analysis of elemental cadmium. The matrix modifier is added to stabilize the cadmium metal and minimize sodium chloride as an interference during the high temperature charring step of the analysis subsection (5)(a) and (b) of this section.

(c) History.

Previously, two OSHA sampling and analytical methods for cadmium were used concurrently WAC 296-62-07449 (5)(c) and (d). Both of these methods also required 0.8 µm mixed cellulose ester membrane filters for the collection of air samples. These cadmium air filter samples were analyzed by either flame atomic absorption spectroscopy (subsection (5)(c) of this section) or inductively coupled plasma/atomic emission spectroscopy (ICP-AES) (subsection (5)(d) of this section). Neither of these two analytical methods have adequate sensitivity for measuring workplace exposure to airborne cadmium at the new lower TWA and action level TWA PEL levels when consecutive samples are taken on one employee and the sample results need to be averaged with other samples to determine a single TWA. The inclusion of two atomic absorption analytical techniques in the new sampling and analysis method for airborne cadmium permits quantitation of sample results over a broad range of exposure levels and sampling periods. The flame AAS analytical technique included in this method is similar to the previous procedure given in the General Metals Method ID-121 (subsection (5)(c) of this section) with some modifications. The sensitivity of the AAS-HGA analytical technique included in this method is adequate to measure exposure levels at 1/10 the action level TWA, or lower, when less than full-shift samples need to be averaged together.

(d) Properties (subsection (5)(e) of this section).

Elemental cadmium is a silver-white, blue-tinged, lustrous metal which is easily cut with a knife. It is slowly oxidized by moist air to form cadmium oxide. It is insoluble in water, but reacts readily with dilute nitric acid. Some of the physical properties and other descriptive information of elemental cadmium are given below:

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CAS No	7440-43-9
Atomic Number	48
Atomic Symbol	Cd
Atomic Weight	112.41
Melting Point	321°C
Boiling Point	765°C
Density	8.65 g/mL (25°C)

The properties of specific cadmium compounds are described in reference subsection (5)(e) of this section.

(e) Method performance.

A synopsis of method performance is presented below. Further information can be found in subsection (4) of this section.

(i) The qualitative and quantitative detection limits for the flame AAS analytical technique are 0.04 µg (0.004 µg/mL) and 0.14 µg (0.014 µg/mL) cadmium, respectively, for a 10 mL solution volume. These correspond, respectively, to 0.2 $\mu g/m^3$ and 0.70 $\mu g/m^3$ for a 200 L air volume.

(ii) The qualitative and quantitative detection limits for the AAS-HGA analytical technique are 0.44 ng (0.044 ng/mL) and 1.5 ng (0.15 ng/mL) cadmium, respectively, for a 10 mL solution volume. These correspond, respectively, to 0.007 $\mu g/m^3$ and 0.025 $\mu g/m^3$ for a 60 L air volume.

(iii) The average recovery by the flame AAS analytical technique of 17 spiked MCEF samples containing cadmium in the range of 0.5 to 2.0 times the TWA target concentration of 5 $\mu g/m^3$ (assuming a 400 L air volume) was 104.0% with a pooled coefficient of variation (CV_1) of 0.010. The flame analytical technique exhibited a positive bias of +4.0% for the validated concentration range. The overall analytical error (OAE) for the flame AAS analytical technique was ±6.0%.

(iv) The average recovery by the AAS-HGA analytical technique of 18 spiked MCEF samples containing cadmium in the range of 0.5 to 2.0 times the action level TWA target concentration of 2.5 $\mu g/m^3$ (assuming a 60 L air volume) was 94.2% with a pooled coefficient of variation (CV_1) of 0.043. The AAS-HGA analytical technique exhibited a negative bias of -5.8% for the validated concentration range. The overall analytical error (OAE) for the AAS-HGA analytical technique was ±14.2%.

(v) Sensitivity in flame atomic absorption is defined as the characteristic concentration of an element required to produce a signal of 1% absorbance (0.0044 absorbance units). Sensitivity values are listed for each element by the atomic absorption spectrophotometer manufacturer and have proved to be a very valuable diagnostic tool to determine if instrumental parameters are optimized and if the instrument is performing up to specification. The sensitivity of the spectrophotometer used in the validation of the flame AAS analytical technique agreed with the manufacturer specifications (subsection (5)(f) of this section); the 2 µg/mL cadmium standard gave an absorbance reading of 0.350 abs. units.

(vi) Sensitivity in graphite furnace atomic absorption is defined in terms of the characteristic mass, the number of picograms required to give an integrated absorbance value of 0.0044 absorbance-second (subsection (5)(g) of this section). Data suggests that under stabilized temperature platform furnace (STPF) conditions (see (f)(ii) of this subsection),

characteristic mass values are transferable between properly functioning instruments to an accuracy of about twenty percent (subsection (5)(b) of this section). The characteristic mass for STPF analysis of cadmium with Zeeman background correction listed by the manufacturer of the instrument used in the validation of the AAS-HGA analytical technique was 0.35 pg. The experimental characteristic mass value observed during the determination of the working range and detection limits of the AAS-HGA analytical technique was 0.41 pg.

(f) Interferences.

(i) High concentrations of silicate interfere in determining cadmium by flame AAS (subsection (5)(f) of this section). However, silicates are not significantly soluble in the acid matrix used to prepare the samples.

(ii) Interferences, such as background absorption, are reduced to a minimum in the AAS-HGA analytical technique by taking full advantage of the stabilized temperature platform furnace (STPF) concept. STPF includes all of the following parameters (subsection (5)(b) of this section):

(A) Integrated absorbance;

(B) Fast instrument electronics and sampling frequency;

(C) Background correction;

(D) Maximum power heating;

(E) Atomization off the L'vov platform in a pyrolytically coated graphite tube;

(F) Gas stop during atomization;

(G) Use of matrix modifiers.

(g) Toxicology (subsection (5)(n) of this section).

Information listed within this section is synopsis of current knowledge of the physiological effects of cadmium and is not intended to be used as the basis for WISHA policy. IARC classifies cadmium and certain of its compounds as Group 2A carcinogens (probably carcinogenic to humans). Cadmium fume is intensely irritating to the respiratory tract. Workplace exposure to cadmium can cause both chronic and acute effects. Acute effects include tracheobronchitis, pneumonitis, and pulmonary edema. Chronic effects include anemia, rhinitis/anosmia, pulmonary emphysema, proteinuria and lung cancer. The primary target organs for chronic disease are the kidneys (noncarcinogenic) and the lungs (carcinogenic).

(2) **Sampling.**

(a) Apparatus.

(i) Filter cassette unit for air sampling: A 37-mm diameter mixed cellulose ester membrane filter with a pore size of 0.8 µm contained in a 37-mm polystyrene two- or three-piece cassette filter holder (part no. MAWP 037 A0, Millipore Corp., Bedford, MA). The filter is supported with a cellulose backup pad. The cassette is sealed prior to use with a shrinkable gel band.

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(ii) A calibrated personal sampling pump whose flow is determined to an accuracy of ±5% at the recommended flow rate with the filter cassette unit in line.

(b) Procedure

(i) Attach the prepared cassette to the calibrated sampling pump (the backup pad should face the pump) using flexible tubing. Place the sampling device on the employee such that air is sampled from the breathing zone.

(ii) Collect air samples at a flow rate of 2.0 L/min. If the filter does not become overloaded, a full-shift (at least seven hours) sample is strongly recommended for TWA and action level TWA measurements with a maximum air volume of 960 L. If overloading occurs, collect consecutive air samples for shorter sampling periods to cover the full workshift.

(iii) Replace the end plugs into the filter cassettes immediately after sampling. Record the sampling conditions.

(iv) Securely wrap each sample filter cassette end-to-end with a sample seal.

(v) Submit at least one blank sample. With each set of air samples. The blank sample should be handled the same as the other samples except that no air is drawn through it.

(vi) Ship the samples to the laboratory for analysis as soon as possible in a suitable container designed to prevent damage in transit.

(3) **Analysis.**

(a) Safety precautions.

(i) Wear safety glasses, protective clothing and gloves at all times.

(ii) Handle acid solutions with care. Handle all cadmium samples and solutions with extra care (see subsection (1)(g) of this section). Avoid their direct contact with work area surfaces, eyes, skin and clothes. Flush acid solutions which contact the skin or eyes with copious amounts of water.

(iii) Perform all acid digestions and acid dilutions in an exhaust hood while wearing a face shield. To avoid exposure to acid vapors, do not remove beakers containing concentrated acid solutions from the exhaust hood until they have returned to room temperature and have been diluted or emptied.

(iv) Exercise care when using laboratory glassware. Do not use chipped pipets, volumetric flasks, beakers or any glassware with sharp edges exposed in order to avoid the possibility of cuts or abrasions.

(v) Never pipet by mouth.

(vi) Refer to the instrument instruction manuals and SOPs (subsection (5)(h) and (i) of this section) for proper and safe operation of the atomic absorption spectrophotometer, raphite furnace atomizer and associated equipment.

(vii) Because metallic elements and other toxic substances are vaporized during AAS flame or graphite furnace atomizer operation, it is imperative that an exhaust vent be used. Always ensure that the exhaust system is operating properly during instrument use.

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(b) Apparatus for sample and standard preparation.

(i) Hot plate, capable of reaching 150°C, installed in an exhaust hood.

(ii) Phillips beakers, 125 mL.

(iii) Bottles, narrow-mouth, polyethylene or glass with leakproof caps: used for storage of standards and matrix modifier.

(iv) Volumetric flasks, volumetric pipets, beakers and other associated general laboratory glassware.

(v) Forceps and other associated general laboratory equipment.

(c) Apparatus for flame AAS analysis.

(i) Atomic absorption spectrophotometer consisting of a(an):

Nebulizer and burner head; pressure regulating devices capable of maintaining constant oxidant and fuel pressures; optical system capable of isolating the desired wavelength of radiation (228.8 nm); adjustable slit; light measuring and amplifying device; display, strip chart, or computer interface for indicating the amount of absorbed radiation; cadmium hollow cathode lamp or electrodeless discharge lamp (EDL) and power supply.

(ii) Oxidant: Compressed air, filtered to remove water, oil and other foreign substances.

(iii) Fuel: Standard commercially available tanks of acetylene dissolved in acetone; tanks should be equipped with flash arresters.

Caution: *Do not use grades of acetylene containing solvents other than acetone because they may damage the PVC tubing used in some instruments.*

(iv) Pressure-reducing valves: Two gauge, two-stage pressure regulators to maintain fuel and oxidant pressures somewhat higher than the controlled operating pressures of the instrument.

(v) Exhaust vent installed directly above the spectrophotometer burner head.

(d) Apparatus for AAS-HGA analysis.

(i) Atomic absorption spectrophotometer consisting of a(an):

Heated graphite furnace atomizer (HGA) with argon purge system pressure-regulating devices capable of maintaining constant argon purge pressure; optical system capable of isolating the desired wavelength of radiation (228.8 nm); adjustable slit; light measuring and amplifying device; display, strip chart, or computer interface for indicating the amount of absorbed radiation (as integrated absorbance, peak area); background corrector: Zeeman or deuterium arc. The Zeeman background corrector is recommended; cadmium hollow cathode lamp or electrodeless discharge lamp (EDL) and power supply; autosampler capable of accurately injecting 5 to 20 µL sample aliquots onto the L'vov Platform in a graphite tube.

(ii) Pyrolytically coated graphite tubes containing solid, pyrolytic L'vov platforms.

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(iii) Polyethylene sample cups, 2.0 to 2.5 mL, for use with the autosampler.

(iv) Inert purge gas for graphite furnace atomizer: Compressed gas cylinder of purified argon.

(v) Two gauge, two-stage pressure regulator for the argon gas cylinder.

(vi) Cooling water supply for graphite furnace atomizer.

(vii) Exhaust vent installed directly above the graphite furnace atomizer.

(e) Reagents. All reagents should be ACS analytical reagent grade or better.

(i) Deionized water with a specific conductance of less than 10 µS.

(ii) Concentrated nitric acid, HNO_3.

(iii) Concentrated hydrochloric acid, HCl.

(iv) Ammonium phosphate, monobasic, $NH_4H_2PO_4$.

(v) Magnesium nitrate, $Mg(NO_3)_2 * 6H_2O$.

(vi) Diluting solution (4% HNO_3, 0.4% HCl): Add 40 mL HNO_3 and 4 mL HCl carefully to approximately 500 mL deionized water and dilute to 1 L with deionized water.

(vii) Cadmium standard stock solution, 1,000 µg/mL: Use a commercially available certified 1,000 µg/mL cadmium standard or, alternatively, dissolve 1.0000 g of cadmium metal in a minimum volume of 1:1 HCl and dilute to 1 L with 4% HNO_3. Observe expiration dates of commercial standards. Properly dispose of commercial standards with no expiration dates or prepared standards one year after their receipt or preparation date.

(viii) Matrix modifier for AAS-HGA analysis: Dissolve 1.0 g $NH_4H_2PO_4$ and 0.15 g $Mg(NO_3)_2 * 6H_2O$ in approximately 200 mL deionized water. Add 1 mL HNO_3 and dilute to 500 mL with deionized water.

(ix) Nitric Acid, 1:1 HNO_3/DI H_2O mixture: Carefully add a measured volume of concentrated HNO_3 to an equal volume of DI H_2O.

(x) Nitric acid, 10% v/v: Carefully add 100 mL of concentrated HNO_3 to 500 mL of DI H_2O and dilute to 1 L.

(f) Glassware preparation.

(i) Clean Phillips beakers by refluxing with 1:1 nitric acid on a hot plate in a fume hood. Thoroughly rinse with deionized water and invert the beakers to allow them to drain dry.

(ii) Rinse volumetric flasks and all other glassware with 10% nitric acid and deionized water prior to use.

(g) Standard preparation for flame AAS analysis.

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(i) Dilute stock solutions: Prepare 1, 5, 10 and 100 µg/mL cadmium standard stock solutions by making appropriate serial dilutions of 1,000 µg/mL cadmium standard stock solution with the diluting solution described in (e)(vi) of this subsection.

(ii) Working standards: Prepare cadmium working standards in the range of 0.02 to 2.0 µg/mL by making appropriate serial dilutions of the dilute stock solutions with the same diluting solution. A suggested method of preparation of the working standards is given below.

Working Standard (µg/mL)	Std Solution (µg/mL)	Aliquot (mL)	Final vol (mL)
0.02	1	10	500
0.05	5	5	500
0.1	10	5	500
0.2	10	10	500
0.5	10	25	500
1	100	5	500
2	100	10	500

Store the working standards in 500-mL, narrow-mouth polyethylene or glass bottles with leak proof caps. Prepare every twelve months.

(h) Standard preparation for AAS-HGA analysis.

(i) Dilute stock solutions: Prepare 10, 100 and 1,000 ng/mL cadmium standard stock solutions by making appropriate ten-fold serial dilutions of the 1,000 µg/mL cadmium standard stock solution with the diluting solution described in (e)(vi) of this subsection.

(ii) Working standards: Prepare cadmium working standards in the range of 0.2 to 20 ng/mL by making appropriate serial dilutions of the dilute stock solutions with the same diluting solution. A suggested method of preparation of the working standards is given below.

Working Standard (ng/mL)	Std Solution (ng/mL)	Aliquot (mL)	Final vol (mL)
0.2	10	2	100
0.5	10	5	100
1	10	10	100
2	100	2	100
5	100	5	100
10	100	10	100
20	1,000	2	100

Store the working standards in narrow-mouth polyethylene or glass bottles with leakproof caps. Prepare monthly.

(i) Sample preparation.

(i) Carefully transfer each sample filter with forceps from its filter cassette unit to a clean, separate 125-mL Phillips beaker along with any loose dust found in the cassette. Label each Phillips beaker with the appropriate sample number.

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(ii) Digest the sample by adding 5 mL of concentrated nitric acid (HNO_3) to each Phillips beaker containing an air filter sample. Place the Phillips beakers on a hot plate in an exhaust hood and heat the samples until approximately 0.5 mL remains. The sample solution in each Phillips beaker should become clear. If it is not clear, digest the sample with another portion of concentrated nitric acid.

(iii) After completing the HNO_3 digestion and cooling the samples, add 40 µL (2 drops) of concentrated HCl to each air sample solution and then swirl the contents. Carefully add about 5 mL of deionized water by pouring it down the inside of each beaker.

(iv) Quantitatively transfer each cooled air sample solution from each Phillips beaker to a clean 10-mL volumetric flask. Dilute each flask to volume with deionized water and mix well.

(j) Flame AAS analysis.

Analyze all of the air samples for their cadmium content by flame atomic absorption spectroscopy (AAS) according to the instructions given below.

(i) Set up the atomic absorption spectrophotometer for the air/acetylene flame analysis of cadmium according to the SOP (subsection (5)(h) of this section) or the manufacturer's operational instructions. For the source lamp, use the cadmium hollow cathode or electrodeless discharge lamp operated at the manufacturer's recommended rating for continuous operation. Allow the lamp to warm up ten to twenty minutes or until the energy output stabilizes. Optimize conditions such as lamp position, burner head alignment, fuel and oxidant flow rates, etc. See the SOP or specific instrument manuals for details. Instrumental parameters for the Perkin-Elmer Model 603 used in the validation of this method are given in subsection (6) of this section.

(ii) Aspirate and measure the absorbance of a standard solution of cadmium. The standard concentration should be within the linear range. For the instrumentation used in the validation of this method a 2 µg/mL cadmium standard gives a net absorbance reading of about 0.350 abs. units (see subsection (1)(e)(v) of this section) when the instrument and the source lamp are performing to manufacturer specifications.

(iii) To increase instrument response, scale expand the absorbance reading of the aspirated 2 µg/mL working standard approximately four times. Increase the integration time to at least three seconds to reduce signal noise.

(iv) Autozero the instrument while aspirating a deionized water blank. Monitor the variation in the baseline absorbance reading (baseline noise) for a few minutes to insure that the instrument, source lamp and associated equipment are in good operating condition.

(v) Aspirate the working standards and samples directly into the flame and record their absorbance readings. Aspirate the deionized water blank immediately after every standard or sample to correct for and monitor any baseline drift and noise. Record the baseline absorbance reading of each deionized water blank. Label each standard and sample reading and its accompanying baseline reading.

(vi) It is recommended that the entire series of working standards be analyzed at the beginning and end of the analysis of a set of samples to establish a concentration-response curve, ensure that the standard readings agree with each other and are reproducible. Also, analyze a working standard after every five or six samples to monitor the performance of the spectrophotometer. Standard readings should agree within ±10 to 15% of the readings obtained at the beginning of the analysis.

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(vii) Bracket the sample readings with standards during the analysis. If the absorbance reading of a sample is above the absorbance reading of the highest working standard, dilute the sample with diluting solution and reanalyze. Use the appropriate dilution factor in the calculations.

(viii) Repeat the analysis of approximately ten percent of the samples for a check of precision.

(ix) If possible, analyze quality control samples from an independent source as a check on analytical recovery and precision.

(x) Record the final instrument settings at the end of the analysis. Date and label the output.

(k) AAS-HGA analysis.

Initially analyze all of the air samples for their cadmium content by flame atomic absorption spectroscopy (AAS) according to the instructions given in (j) of this subsection. If the concentration of cadmium in a sample solution is less than three times the quantitative detection limit (0.04 µg/mL (40 ng/mL) for the instrumentation used in the validation) and the sample results are to be averaged with other samples for TWA calculations, proceed with the AAS-HGA analysis of the sample as described below.

(i) Set up the atomic absorption spectrophotometer and HGA for flameless atomic absorption analysis of cadmium according to the SOP (subsection (5)(i) of this section) or the manufacturer's operational instructions and allow the instrument to stabilize. The graphite furnace atomizer is equipped with a pyrolytically coated graphite tube containing a pyrolytic platform. For the source lamp, use a cadmium hollow cathode or electrodeless discharge lamp operated at the manufacturer's recommended setting for graphite furnace operation. The Zeeman background corrector and EDL are recommended for use with the L'vov platform. Instrumental parameters for the Perkin-Elmer Model 5100 spectrophotometer and Zeeman HGA-600 graphite furnace used in the validation of this method are given in subsection (7) of this section.

(ii) Optimize the energy reading of the spectrophotometer at 228.8 nm by adjusting the lamp position and the wavelength according to the manufacturer's instructions.

(iii) Set up the autosampler to inject a 5-µL aliquot of the working standard, sample or reagent blank solution onto the L'vov platform along with a 10-µL overlay of the matrix modifier.

(iv) Analyze the reagent blank (diluting solution, (e)(vi) of this subsection) and then autozero the instrument before starting the analysis of a set of samples. It is recommended that the reagent blank be analyzed several times during the analysis to assure the integrated absorbance (peak area) reading remains at or near zero.

(v) Analyze a working standard approximately midway in the linear portion of the working standard range two or three times to check for reproducibility and sensitivity (see subsection (1)(e)(v) and (vi) of this section) before starting the analysis of samples. Calculate the experimental characteristic mass value from the average integrated absorbance reading and injection volume of the analyzed working standard. Compare this value to the manufacturer's suggested value as a check of proper instrument operation.

(vi) Analyze the reagent blank, working standard, and sample solutions. Record and label the peak area (abs-sec) readings and the peak and background peak profiles on the printer/plotter.

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(vii) It is recommended the entire series of working standards be analyzed at the beginning and end of the analysis of a set of samples. Establish a concentration-response curve and ensure standard readings agree with each other and are reproducible. Also, analyze a working standard after every five or six samples to monitor the performance of the system. Standard readings should agree within ±15% of the readings obtained at the beginning of the analysis.

(viii) Bracket the sample readings with standards during the analysis. If the peak area reading of a sample is above the peak area reading of the highest working standard, dilute the sample with the diluting solution and reanalyze. Use the appropriate dilution factor in the calculations.

(ix) Repeat the analysis of approximately ten percent of the samples for a check of precision.

(x) If possible, analyze quality control samples from an independent source as a check of analytical recovery and precision.

(xi) Record the final instrument settings at the end of the analysis. Date and label the output.

(l) Calculations.

Note: Standards used for HGA analysis are in ng/mL. Total amounts of cadmium from calculations will be in ng (not µg) unless a prior conversion is made.

(i) Correct for baseline drift and noise in flame AAS analysis by subtracting each baseline absorbance reading from its corresponding working standard or sample absorbance reading to obtain the net absorbance reading for each standard and sample.

(ii) Use a least squares regression program to plot a concentration-response curve of net absorbance reading (or peak area for HGA analysis) versus concentration (µg/mL or ng/mL) of cadmium in each working standard.

(iii) Determine the concentration (µg/mL or ng/mL) of cadmium in each sample from the resulting concentration-response curve. If the concentration of cadmium in a sample solution is less than three times the quantitative detection limit (0.04 µg/mL (40 ng/mL) for the instrumentation used in the validation of the method) and if consecutive samples were taken on one employee and the sample results are to be averaged with other samples to determine a single TWA, reanalyze the sample by

AAS-HGA as described in (k) of this subsection and report the AAS-HGA analytical results.

(iv) Calculate the total amount (µg or ng) of cadmium in each sample from the sample solution volume (mL):

W = (C)(sample vol, mL)(DF)

Where: W = Total cadmium in sample

C = Calculated concentration of cadmium

DF = Dilution Factor (if applicable)

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(v) Make a blank correction for each air sample by subtracting the total amount of cadmium in the corresponding blank sample from the total amount of cadmium in the sample.

(vi) Calculate the concentration of cadmium in an air sample (mg/ m^3or µg/m^3) by using one of the following equations:

$mg/m^3 = W^{bc}/(\text{Air vol sampled, L})$

or

$\mu g/m^3 = (W^{bc})(1{,}000 \text{ ng}/\mu g)/(\text{Air vol sampled, L})$

Where: W^{bc} = blank corrected total µg cadmium in the sample.

(1µg = 1,000 ng)

(4) **Backup data.**

(a) Introduction.

(i) The purpose of this evaluation is to determine the analytical method recovery, working standard range, and qualitative and quantitative detection limits of the two atomic absorption analytical techniques included in this method. The evaluation consisted of the following experiments:

(A) An analysis of twenty-four samples (six samples each at 0.1, 0.5, 1 and 2 times the TWA-PEL) for the analytical method recovery study of the flame AAS analytical technique.

(B) An analysis of eighteen samples (six samples each at 0.5, 1 and 2 times the action level TWA-PEL) for the analytical method recovery study of the AAS-HGA analytical technique.

(C) Multiple analyses of the reagent blank and a series of standard solutions to determine the working standard range and the qualitative and quantitative detection limits for both atomic absorption analytical techniques.

(ii) The analytical method recovery results at all test levels were calculated from concentration-response curves and statistically examined for outliers at the ninety-nine percent confidence level. Possible outliers were determined using the Treatment of Outliers test (subsection (5)(j) of this section). In addition, the sample results of the two analytical techniques, at 0.5, 1.0 and 2.0 times their target concentrations, were tested for homogeneity of variances also at the ninety-nine percent confidence level. Homogeneity of the coefficients of variation was determined using the Bartlett's test (subsection (5)(k) of this section). The overall analytical error (OAE) at the ninety-five percent confidence level was calculated using the equation (subsection (5)(l) of this section):

$$OAE = \pm [\ |\text{Bias}|\ + (1.96)(CV_1 \text{ (pooled)})(100\%)]$$

(iii) A derivation of the International Union of Pure and Applied Chemistry (IUPAC) detection limit equation (subsection (5)(m) of this section) was used to determine the qualitative and quantitative detection limits for both atomic absorption analytical techniques:

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$$C_{ld} = k(sd)/m \qquad \text{(Equation 1)}$$

Where: C_{ld} = the smallest reliable detectable concentration an analytical instrument can determine at a given confidence level.

k = 3 for the Qualitative Detection Limit at the 99.86% Confidence Level

k = 10 for the Quantitative Detection Limit at the 99.99% Confidence Level.

sd = standard deviation of the reagent blank (Rbl) readings.

m = analytical sensitivity or slope as calculated by linear regression.

(iv) Collection efficiencies of metallic fume and dust atmospheres on 0.8-µm mixed cellulose ester membrane filters are well documented and have been shown to be excellent (subsection (5)(k) of this section). Since elemental cadmium and the cadmium component of cadmium compounds are nonvolatile, stability studies of cadmium spiked MCEF samples were not performed.

(b) Equipment.

(i) A Perkin-Elmer (PE) Model 603 spectrophotometer equipped with a manual gas control system, a stainless steel nebulizer, a burner mixing chamber, a flow spoiler and a 10 cm (one-slot) burner head was used in the experimental validation of the flame AAS analytical technique. A PE cadmium hollow cathode lamp, operated at the manufacturer's recommended current setting for continuous operation (4 mA), was used as the source lamp. Instrument parameters are listed in subsection (6) of this section.

(ii) A PE Model 5100 spectrophotometer, Zeeman HGA-600 graphite furnace atomizer and AS-60 HGA autosampler were used in the experimental validation of the AAS-HGA analytical technique. The spectrophotometer was equipped with a PE Series 7700 professional computer and Model PR-310 printer. A PE System 2 cadmium electrodeless discharge lamp, operated at the manufacturer's recommended current setting for modulated operation (170 mA), was used as the source lamp. Instrument parameters are listed in subsection (7) of this section.

(c) Reagents.

(i) J.T. Baker Chem. Co. (Analyzed grade) concentrated nitric acid, 69.0-71.0%, and concentrated hydrochloric acid, 36.5-38.0%, were used to prepare the samples and standards.

(ii) Ammonium phosphate, monobasic, $NH_4H_2PO_4$ and magnesium nitrate hexahydrate, $Mg(NO_3)2.6\ H_2O$ both manufactured by the Mallinckrodt Chem. Co., were used to prepare the matrix modifier for AAS-HGA analysis.

(d) Standard preparation for flame AAS analysis.

(i) Dilute stock solutions: Prepared 0.01, 0.1, 1, 10 and 100 µg/mL cadmium standard stock solutions by making appropriate serial dilutions of a commercially available 1,000 µg/mL cadmium standard stock solution (RICCA Chemical Co., Lot# A102) with the diluting solution (4% HNO_3, 0.4% HCl).

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(ii) Analyzed standards: Prepared cadmium standards in the range of 0.001 to 2.0 µg/mL by pipetting 2 to 10 mL of the appropriate dilute cadmium stock solution into a 100-mL volumetric flask and diluting to volume with the diluting solution. (See subsection (3)(g)(ii) of this section).

(e) Standard preparation for AAS-HGA analysis.

(i) Dilute stock solutions: Prepared 1, 10, 100 and 1,000 ng/mL cadmium standard stock solutions by making appropriate serial dilutions of a commercially available 1,000 µg/mL cadmium standard stock solution (J.T. Baker Chemical Co., Instra-analyzed, Lot# D22642) with the diluting solution (4% HNO_3, 0.4% HCl).

(ii) Analyzed standards: Prepared cadmium standards in the range of 0.1 to 40 ng/mL by pipetting 2 to 10 mL of the appropriate dilute cadmium stock solution into a 100-mL volumetric flask and diluting to volume with the diluting solution. (See subsection (3)(h)(ii) of this section).

(f) Detection limits and standard working range for flame AAS analysis.

(i) Analyzed the reagent blank solution and the entire series of cadmium standards in the range of 0.001 to 2.0 µg/mL three to six times according to the instructions given in subsection (3)(j) of this section. The diluting solution (4% HNO_3, 0.4% HCl) was used as the reagent blank. The integration time on the PE 603 spectrophotometer was set to 3.0 seconds and a four-fold expansion of the absorbance reading of the 2.0 µg/mL cadmium standard was made prior to analysis. The 2.0 µg/mL standard gave a net absorbance reading of 0.350 abs. units prior to expansion in agreement with the manufacturer's specifications (subsection (5)(f) of this section).

(ii) The net absorbance readings of the reagent blank and the low concentration Cd standards from 0.001 to 0.1 µg/mL and the statistical analysis of the results are shown in Table 1. The standard deviation, sd, of the six net absorbance readings of the reagent blank is 1.05 abs. units. The slope, m, as calculated by a linear regression plot of the net absorbance readings (shown in Table 2) of the 0.02 to 1.0 µg/mL cadmium standards versus their concentration is 772.7 abs. units/(µg/mL).

(iii) If these values for sd and the slope, m, are used in Eqn. 1 ((a)(ii) of this subsection), the qualitative and quantitative detection limits as determined by the IUPAC Method are:

C_{ld} = (3)(1.05 abs. units)/(772.7 abs. units/(µg/mL)) = 0.0041 µg/mL for the qualitative detection limit.

C_{ld} = (10)(1.05 abs. units)/(772.7 abs. units/(µg/mL)) = 0.014 µg/mL for the quantitative detection limit.

The qualitative and quantitative detection limits for the flame AAS analytical technique are 0.041 µg and 0.14 µg cadmium, respectively, for a 10 mL solution volume. These correspond, respectively, to 0.2 µg/m^3 and 0.70 µg/m^3 for a 200 L air volume.

(iv) The recommended Cd standard working range for flame AAS analysis is 0.02 to 2.0 µg/mL. The net absorbance readings of the reagent blank and the recommended working range standards and the statistical analysis of the results are shown in Table 2. The standard of lowest concentration in the working range, 0.02 µg/mL, is slightly greater than the calculated quantitative detection limit, 0.014 µg/mL. The standard of highest concentration in the working range, 2.0 µg/mL, is at the upper end of the linear working

range suggested by the manufacturer (subsection (5)(f) of this section). Although the standard net absorbance readings are not strictly linear at concentrations above 0.5 µg/mL, the deviation from linearity is only about ten percent at the upper end of the recommended standard working range. The deviation from linearity is probably caused by the four-fold expansion of the signal suggested in the method. As shown in Table 2, the precision of the standard net absorbance readings are excellent throughout the recommended working range; the relative standard deviations of the readings range from 0.009 to 0.064.

(g) Detection limits and standard working range for AAS-HGA analysis.

(i) Analyzed the reagent blank solution and the entire series of cadmium standards in the range of 0.1 to 40 ng/mL according to the instructions given in subsection (3)(k) of this section. The diluting solution (4% HNO_3, 0.4% HCl) was used as the reagent blank. A fresh aliquot of the reagent blank and of each standard was used for every analysis. The experimental characteristic mass value was 0.41 pg, calculated from the average peak area (abs-sec) reading of the 5 ng/mL standard which is approximately midway in the linear portion of the working standard range. This agreed within twenty percent with the characteristic mass value, 0.35 pg, listed by the manufacturer of the instrument (subsection (5)(b) of this section).

(ii) The peak area (abs-sec) readings of the reagent blank and the low concentration Cd standards from 0.1 to 2.0 ng/mL and statistical analysis of the results are shown in Table 3. Five of the reagent blank peak area readings were zero and the sixth reading was 1 and was an outlier. The near lack of a blank signal does not satisfy a strict interpretation of the IUPAC method for determining the detection limits. Therefore, the standard deviation of the six peak area readings of the 0.2 ng/mL cadmium standard, 0.75 abs-sec, was used to calculate the detection limits by the IUPAC method. The slope, m, as calculated by a linear regression plot of the peak area (abs-sec) readings (shown in Table 4) of the 0.2 to 10 ng/mL cadmium standards versus their concentration is 51.5 abs-sec/(ng/mL).

(iii) If 0.75 abs-sec (sd) and 51.5 abs-sec/(ng/mL) (m) are used in Eqn. 1 ((a)(iii) of this subsection), the qualitative and quantitative detection limits as determined by the IUPAC method are:

C_{ld} = (3)(0.75 abs-sec)/(51.5 abs-sec/(ng/mL) = 0.044 ng/mL for the qualitative detection limit.

C_{ld} = (10)(0.75 abs-sec)/(51.5 abs-sec/(ng/mL) = 0.15 ng/mL for the quantitative detection limit.

The qualitative and quantitative detection limits for the AAS-HGA analytical technique are 0.44 ng and 1.5 ng cadmium, respectively, for a 10 mL solution volume. These correspond, respectively, to 0.007 µg/m^3 and 0.025 µg/m^3 for a 60 L air volume.

(iv) The peak area (abs-sec) readings of the Cd standards from 0.2 to 40 ng/mL and the statistical analysis of the results are given in Table 4. The recommended standard working range for AAS-HGA analysis is 0.2 to 20 ng/mL. The standard of lowest concentration in the recommended working range is slightly greater than the calculated quantitative detection limit, 0.15 ng/mL. The deviation from linearity of the peak area readings of the 20 ng/mL standard, the highest concentration standard in the recommended working range, is approximately ten percent. The deviations from linearity of the peak area readings of the thirty and forty ng/mL standards are significantly greater than ten percent.

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As shown in Table 4, the precision of the peak area readings are satisfactory throughout the recommended working range; the relative standard deviations of the readings range from 0.025 to 0.083.

(h) Analytical method recovery for flame AAS analysis.

(i) Four sets of spiked MCEF samples were prepared by injecting 20 µL of 10, 50, 100 and 200 µg/mL dilute cadmium stock solutions on 37 mm diameter filters (part No. AAWP 037 00, Millipore Corp., Bedford, MA) with a calibrated micropipet. The dilute stock solutions were prepared by making appropriate serial dilutions of a commercially available 1,000 µg/mL cadmium standard stock solution (RICCA Chemical Co., Lot # A102) with the diluting solution (4% HNO_3, 0.4% HCl). Each set contained six samples and a sample blank. The amount of cadmium in the prepared sets were equivalent to 0.1, 0.5, 1.0 and 2.0 times the TWA PEL target concentration of 5 $\mu g/m^3$ for a 400 L air volume.

(ii) The air-dried spiked filters were digested and analyzed for their cadmium content by flame atomic absorption spectroscopy (AAS) following the procedure described in subsection (3) of this section. The 0.02 to 2.0 µg/mL cadmium standards (the suggested working range) were used in the analysis of the spiked filters.

(iii) The results of the analysis are given in Table 5. One result at 0.5 times the TWA PEL target concentration was an outlier and was excluded from statistical analysis. Experimental justification for rejecting it is that the outlier value was probably due to a spiking error. The coefficients of variation for the three test levels at 0.5 to 2.0 times the TWA PEL target concentration passed the Bartlett's test and were pooled.

(iv) The average recovery of the six spiked filter samples at 0.1 times the TWA PEL target concentration was 118.2% with a coefficient of variation (CV_1) of 0.128. The average recovery of the spiked filter samples in the range of 0.5 to 2.0 times the TWA target concentration was 104.0% with a pooled coefficient of variation (CV_1) of 0.010. Consequently, the analytical bias found in these spiked sample results over the tested concentration range was +4.0% and the OAE was ±6.0%.

(i) Analytical method recovery for AAS-HGA analysis.

(i) Three sets of spiked MCEF samples were prepared by injecting 15 µL of 5, 10 and 20 µg/mL dilute cadmium stock solutions on 37 mm diameter filters (part no. AAWP 037 00, Millipore Corp., Bedford, MA) with a calibrated micropipet. The dilute stock solutions were prepared by making appropriate serial dilutions of a commercially available certified 1,000 µg/mL cadmium standard stock solution (Fisher Chemical Co., Lot# 913438-24) with the diluting solution (4% HNO_3, 0.4% HCl). Each set contained six samples and a sample blank. The amount of cadmium in the prepared sets were equivalent to 0.5, 1 and 2 times the action level TWA target concentration of 2.5 $\mu g/m^3$ for a 60 L air volume.

(ii) The air-dried spiked filters were digested and analyzed for their cadmium content by flameless atomic absorption spectroscopy using a heated graphite furnace atomizer following the procedure described in subsection (3) of this section. A five-fold dilution of the spiked filter samples at 2 times the action level TWA was made prior to their analysis. The 0.05 to 20 ng/mL cadmium standards were used in the analysis of the spiked filters.

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(iii) The results of the analysis are given in Table 6. There were no outliers. The coefficients of variation for the three test levels at 0.5 to 2.0 times the action level TWA PEL passed the Bartlett's test and were pooled. The average recovery of the spiked filter samples was 94.2% with a pooled coefficient of variation (CV_1) of 0.043. Consequently, the analytical bias was -5.8% and the OAE was ±14.2%.

(j) Conclusions.

The experiments performed in this evaluation show the two atomic absorption analytical techniques included in this method to be precise and accurate and have sufficient sensitivity to measure airborne cadmium over a broad range of exposure levels and sampling periods.

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Table 1-Cd Detection Limit Study
[Flame AAS Analysis]

STD (µg/mL)	Absorbance reading at 228.8 nm		Statistical analysis
Reagent blank	5 4 4	2 3 3	n = 6. mean = 3.50. std dev = 1.05. CV = 0.30.
0.001	6 2 6	6 4 6	n = 6. mean = 5.00. std dev = 1.67. CV = 0.335.
0.002	5 7 7	7 3 4	n = 6. mean = 5.50. std dev = 1.76. CV =0 .320.
0.005	7 8 8	7 8 6	n = 6. mean = 7.33. std dev = 0.817. CV = 0.111.
0.010	10 10 10	9 13 10	n = 6. mean = 10.3. std dev = 1.37. CV = 0.133.
0.020	20 20 20	23 22 20	n = 6. mean = 20.8. std dev = 1.33. CV = 0.064.
0.050	42 42 42	42 42 45	n = 6. mean = 42.5. std dev = 1.22. CV = 0.029.
0.10		84 80 83	n = 3. mean = 82.3. std dev = 2.08. CV = 0.025.

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Table 2--Cd Standard Working Range Study
[Flame AAS Analysis]

STD (µg/mL)	Absorbance reading at 228.8 nm		Statistical analysis
Reagent blank	5	2	n = 6.
	4	3	mean = 3.50.
	4	3	std dev = 1.05.
			CV = 0.30.
0.020	20	23	n = 6.
	20	22	mean = 20.8.
	20	20	std dev = 1.33.
			CV = 0.064.
0.050	42	42	n = 6.
	42	42	mean = 42.5.
	42	45	std dev = 1.22.
			CV = 0.029.
0.10		84	n = 3.
		80	mean = 82.3.
		83	std dev = 2.08.
			CV = 0.025.
0.20		161	n = 3.
		161	mean = 160.0.
		158	std dev = 1.73.
			CV = 0.011.
0.50		391	n = 3.
		389	mean = 391.0.
		393	std dev = 2.00.
			CV = 0.005.
1.00		760	n = 3.
		748	mean = 753.3.
		752	std dev = 6.11.
			CV = 0.008.
2.00		1416	n = 3.
		1426	mean = 1414.3.
		1401	std dev = 12.6.
			CV = 0.009.

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Table 3--Cd Detection Limit Study
[AAS-HGA Analysis]

STD (ng/mL)	Peak area Readings x 10^3 at 228.8 nm		Statistical analysis
Reagent blank	0	0	n = 6.
	0	1	mean = 0.167.
	0	0	std dev = 0.41.
			CV = 2.45.
0.1	8	6	n = 6.
	5	7	mean = 7.7.
	13	7	std dev = 2.8.
			CV = 0.366.
0.2	11	13	n = 6.
	11	12	mean = 11.8.
	12	12	std dev = 0.75.
			CV = 0.064.
0.5	28	33	n = 6.
	26	28	mean = 28.8.
	28	30	std dev = 2.4.
			CV = 0.083.
1.0	52	55	n = 6.
	56	58	mean = 54.8.
	54	54	std dev = 2.0.
			CV = 0.037.
2.0	101	112	n = 6.
	110	110	mean = 108.8.
	110	110	std dev = 3.9.
			CV = 0.036.

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Table 4--Cd Standard Working Range Study [AAS-HGA Analysis]

STD (ng/mL)	Peak area Readings x 10^3 at 228.8 nm		Statistical analysis
0.2	11 11 12	13 12 12	n = 6. mean = 11.8. std dev = 0.75. CV = 0.064.
0.5	28 26 28	33 28 30	n = 6. mean = 28.8. std dev = 2.4. CV = 0.083.
1.0	52 56 54	55 58 54	n = 6. mean = 54.8. std dev = 2.0. CV = 0.037.
2.0	101 110 110	112 110 110	n = 6. mean = 108.8. std dev = 3.9. CV = 0.036.
5.0	247 268 259	265 275 279	n = 6. mean = 265.5. std dev = 11.5. CV = 0.044.
10.0	495 523 516	520 513 533	n = 6. mean = 516.7. std dev = 12.7. CV = 0.025.
20.0	950 951 949	953 958 890	n = 6. mean = 941.8. std dev = 25.6. CV = 0.027.
30.0	1269 1303 1295	1291 1307 1290	n = 6. mean = 1293. std dev = 13.3. CV = 0.010.
40.0	1505 1535 1566	1567 1567 1572	n = 6. mean = 1552. std dev = 26.6. CV = 0.017.

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Table 5--Analytical Method Recovery
[Flame AAS Analysis]
Test Level

µg taken	0.5x µg found	Percent rec.	µg taken	1.0x µg found	Percent rec.	µg taken	2.0x µg found	Percent rec.
1.00	1.0715	107.2	2.00	2.0688	103.4	4.00	4.1504	103.8
1.00	1.0842	108.4	2.00	2.0174	100.9	4.00	4.1108	102.8
1.00	1.0842	108.4	2.00	2.0431	102.2	4.00	4.0581	101.5
1.00	*1.0081	*100.8	2.00	2.0431	102.2	4.00	4.0844	102.1
1.00	1.0715	107.2	2.00	2.0174	100.9	4.00	4.1504	103.8
1.00		108.4	2.00	2.0045	100.2	4.00	4.1899	104.7

n =	5	6	6
mean =	107.9	101.6	103.1
std dev =	0.657	1.174	1.199
CV_1 =	0.006	0.011	0.012

CV_1 (pooled) = 0.010

*Rejected as an outlier-this value did not pass the outlier T-test at the 99% confidence level.

Test Level
0.1x

µg taken	µg found	Percent rec.
0.200	0.2509	125.5
0.200	0.2509	125.5
0.200	0.2761	138.1
0.200	0.2258	112.9
0.200	0.2258	112.9
0.200	0.1881	94.1

n =	6
mean =	118.2
std dev =	15.1
CV_1 =	0.128

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Table 6-Analytical Method Recovery
[AAS-HGA analysis]
Test Level

ng taken	0.5x ng found	Percent rec.	ng taken	1.0x ng found	Percent rec.	ng taken	2.0x ng found	Percent rec.
75	71.23	95.0	150	138.00	92.0	300	258.43	86.1
75	71.47	95.3	150	138.29	92.2	300	258.46	86.2
75	70.02	93.4	150	136.30	90.9	300	280.55	93.5
75	77.34	103.1	150	146.62	97.7	300	288.34	96.1
75	78.32	104.4	150	145.17	96.8	300	261.74	87.2
75	71.96	95.9.	150	144.88	96.6	300	277.22	92.4
n =	6			6			6	
mean =	97.9			94.4			90.3	
std dev =	4.66			2.98			4.30	
CV_1 =	0.048			0.032			0.048	

CV_1 (pooled) = 0.043

(6) Instrumental Parameters for Flame AAS Analysis
Atomic Absorption Spectrophotometer
(Perkin-Elmer Model 603)
Flame: Air/Acetylene--lean, blue
Oxidant Flow: 55
Fuel Flow: 32
Wavelength: 228.8 nm
Slit: 4 (0.7 nm)
Range: UV
Signal: Concentration (4 exp)
Integration Time: 3 sec

(7) Instrumental Parameters for HGA Analysis
Atomic Absorption Spectrophotometer
(Perkin-Elmer Model 5100)
Signal Type: Zeeman AA
Slitwidth: 0.7 nm
Wavelength: 228.8 nm
Measurement: Peak Area
Integration Time: 6.0 sec
BOC Time: 5 sec BOC = Background Offset
Correction. Zeeman Graphite Furnace
(Perkin-Elmer Model HGA-600)

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Step	Ramp Time (sec)	Hold Time (sec)	Temp (°C)	Argon Flow (mL/min)	Read (sec)
1) Predry	5	10	90	300	--
2) Dry	30	10	140	300	--
3) Char	10	20	900	300	--
4) Cool Down	1	8	30	300	--
5) Atomize	0	5	1600	0	-1
6) Burnout	1	8	2500	300	--

[Statutory Authority: Chapter 49.17 RCW. 93-21-075 (Order 93-06), § 296-62-07449, filed 10/20/93, effective 12/1/93; 93-07-044 (Order 93-01), § 296-62-07449, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07451 A short description of Appendix F to 29 CFR 1910.1027--Nonmandatory protocol for biological monitoring. Appendix F is not included in this standard due to limited employer/employee application. The following is a brief synopsis of the content of Appendix F to 29 CFR 1910.1027, Cadmium.

(1) The medical monitoring program for cadmium requires that blood and urine samples must be collected at defined intervals from workers by physicians responsible for medical monitoring. These samples are sent to commercial laboratories that perform the required analyses and report results of these analyses to the responsible physicians. To ensure the accuracy and reliability of these laboratory analyses, the laboratories to which samples are submitted should participate in an ongoing and efficacious proficiency testing program.

(2) This nonmandatory protocol is intended to provide guidelines and recommendations for physicians and laboratories to improve the accuracy and reliability of the procedures used to analyze the biological samples collected as part of the medical monitoring program for cadmium. This protocol provides procedures for characterizing and maintaining the quality of analytic results derived from the analyses of cadmium in blood (CDB), cadmium in urine (CDU), and beta-2-microglobulin in urine (B2MU) by commercial laboratories. Laboratories conforming to the provisions of this nonmandatory protocol shall be known as "participating laboratories."

(3) This protocol describes procedures that may be used by the responsible physicians to identify laboratories most likely to be proficient in the analysis of samples used in the biological monitoring of cadmium. It also provides procedures for record keeping and reporting by laboratories participating in proficiency testing programs, and recommendations to assist these physicians in interpreting analytical results determined by participating laboratories.

(4) For those needing Appendix F, 29 CFR 1910.1027, in its entirety, a copy may be obtained by request to:

Department of Labor and Industries
Division of Industrial Safety and Health
Standards and Information
Post Office Box 44620
Olympia, Washington 98504-4620
or telephone (360) 956-5527

[Statutory Authority: Chapter 49.17 RCW. 93-07-044 (Order 93-01), § 296-62-07451, filed 3/13/93, effective 4/27/93.]

WAC 296-62-07460 Butadiene.

(1) **Scope and application.**

(a) This section applies to all occupational exposures to 1,3-Butadiene (BD), Chemical Abstracts Service Registry No. 106-99-0, except as provided in (b) of this subsection.

(b)(i) Except for the recordkeeping provisions in subsection (13)(a) of this section, this section does not apply to the processing, use, or handling of products containing BD or to other work operations and streams in which BD is present where objective data are reasonably relied upon that demonstrate the work operation or the product or the group of products or operations to which it belongs may not reasonably be foreseen to release BD in airborne concentrations at or above the action level or in excess of the STEL under the expected conditions of processing, use, or handling that will cause the greatest possible release or in any plausible accident.

(ii) This section also does not apply to work operations, products or streams where the only exposure to BD is from liquid mixtures containing 0.1% or less of BD by volume or the vapors released from such liquids, unless objective data become available that show that airborne concentrations generated by such mixtures can exceed the action level or STEL under reasonably predictable conditions of processing, use or handling that will cause the greatest possible release.

(iii) Except for labeling requirements and requirements for emergency response, this section does not apply to the storage, transportation, distribution or sale of BD or liquid mixtures in intact containers or in transportation pipelines sealed in such a manner as to fully contain BD vapors or liquids.

(c) Where products or processes containing BD are exempted under (b) of this subsection, the employer shall maintain records of the objective data supporting that exemption and the basis for the employer's reliance on the data, as provided in subsection (13)(a) of this section.

(2) **Definitions:** For the purpose of this section, the following definitions shall apply:

"Action level" means a concentration of airborne BD of 0.5 ppm calculated as an 8-hour time-weighted average.

"Director" means the director of the department of labor and industries, or authorized representatives.

"Authorized person" means any person specifically designated by the employer, whose duties require entrance into a regulated area, or a person entering such an area as a designated representative of employees to exercise the right to observe monitoring and measuring procedures under subsection (4)(h) of this section, or a person designated under the WISH Act or regulations issued under the WISH Act to enter a regulated area.

"1,3-Butadiene" means an organic compound with chemical formula $CH_2 = CHCH = CH_2$ that has a molecular weight of approximately 54.15 gm/mole.

"Business day" means any Monday through Friday, except those days designated as federal, state, local or company specific holidays.

"Complete blood count (CBC)" means laboratory tests performed on whole blood specimens and includes the following: White blood cell count (WBC), hematocrit (Hct), red blood cell count (RBC), hemoglobin (Hgb), differential count of white blood cells, red blood cell morphology, red blood cell indices, and platelet count.

"Day" means any part of a calendar day.

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"Emergency situation" means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment that may or does result in an uncontrolled significant release of BD.

"Employee exposure" means exposure of a worker to airborne concentrations of BD which would occur if the employee were not using respiratory protective equipment.

"Objective data" means monitoring data, or mathematical modelling or calculations based on composition, chemical and physical properties of a material, stream or product.

"Permissible exposure limits (PELs)" means either the 8-hour time-weighted average (8-hr TWA) exposure or the short-term exposure limit (STEL).

"Physician or other licensed health care professional" is an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide one or more of the specific health care services required by (k) of this subsection.

"Regulated area" means any area where airborne concentrations of BD exceed or can reasonably be expected to exceed the 8-hour time-weighted average (8-hr TWA) exposure of 1 ppm or the short-term exposure limit (STEL) of 5 ppm for 15 minutes.

"This section" means this 1,3-butadiene standard.

(3) **Permissible exposure limits (PELs).**

(a) Time-weighted average (TWA) limit. The employer shall ensure that no employee is exposed to an airborne concentration of BD in excess of one part BD per million parts of air (ppm) measured as an eight (8)-hour time-weighted average.

(b) Short-term exposure limit (STEL). The employer shall ensure that no employee is exposed to an airborne concentration of BD in excess of five parts of BD per million parts of air (5 ppm) as determined over a sampling period of fifteen minutes.

(4) **Exposure monitoring.**

(a) General.

(i) Determinations of employee exposure shall be made from breathing zone air samples that are representative of the 8-hour TWA and 15-minute short-term exposures of each employee.

(ii) Representative 8-hour TWA employee exposure shall be determined on the basis of one or more samples representing full-shift exposure for each shift and for each job classification in each work area.

(iii) Representative 15-minute short-term employee exposures shall be determined on the basis of one or more samples representing 15-minute exposures associated with operations that are most likely to produce exposures above the STEL for each shift and for each job classification in each work area.

(iv) Except for the initial monitoring required under (b) of this subsection, where the employer can document that exposure levels are equivalent for similar operations on different work shifts, the employer need only determine representative employee exposure for that operation from the shift during which the highest exposure is expected.

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(b) Initial monitoring.

(i) Each employer who has a workplace or work operation covered by this section, shall perform initial monitoring to determine accurately the airborne concentrations of BD to which employees may be exposed, or shall rely on objective data pursuant to subsection (1)(b)(i) of this section to fulfill this requirement.

(ii) Where the employer has monitored within two years prior to the effective date of this section and the monitoring satisfies all other requirements of this section, the employer may rely on such earlier monitoring results to satisfy the requirements of (b)(i) of this subsection, provided that the conditions under which the initial monitoring was conducted have not changed in a manner that may result in new or additional exposures.

(c) Periodic monitoring and its frequency.

(i) If the initial monitoring required by (b) of this subsection reveals employee exposure to be at or above the action level but at or below both the 8-hour TWA limit and the STEL, the employer shall repeat the representative monitoring required by (a) of this subsection every twelve months.

(ii) If the initial monitoring required by (b) of this subsection reveals employee exposure to be above the 8-hour TWA limit, the employer shall repeat the representative monitoring required by (a)(ii) of this subsection at least every three months until the employer has collected two samples per quarter (each at least 7 days apart) within a two-year period, after which such monitoring must occur at least every six months.

(iii) If the initial monitoring required by (b) of this subsection reveals employee exposure to be above the STEL, the employer shall repeat the representative monitoring required by (a)(iii) of this subsection at least every three months until the employer has collected two samples per quarter (each at least 7 days apart) within a two-year period, after which such monitoring must occur at least every six months.

(iv) The employer may alter the monitoring schedule from every six months to annually for any required representative monitoring for which two consecutive measurements taken at least 7 days apart indicate that employee exposure has decreased to or below the 8-hour TWA, but is at or above the action level.

(d) Termination of monitoring.

(i) If the initial monitoring required by (b) of this subsection reveals employee exposure to be below the action level and at or below the STEL, the employer may discontinue the monitoring for employees whose exposures are represented by the initial monitoring.

(ii) If the periodic monitoring required by (c) of this subsection reveals that employee exposures, as indicated by at least two consecutive measurements taken at least 7 days apart, are below the action level and at or below the STEL, the employer may discontinue the monitoring for those employees who are represented by such monitoring.

(e) Additional monitoring.

(i) The employer shall institute the exposure monitoring required under subsection (4) of this section whenever there has been a change in the production, process, control equipment, personnel or work-practices that may result in new or additional exposures to BD or when the employer has any reason to suspect that a change may result in new or additional exposures.

(ii) Whenever spills, leaks, ruptures or other breakdowns occur that may lead to employee exposure above the 8-hr TWA limit or above the STEL, the employer shall monitor (using leak source, such as direct reading instruments, area or personal monitoring), after the cleanup of the spill or repair of the leak, rupture or other breakdown, to ensure that exposures have returned to the level that existed prior to the incident.

(f) Accuracy of monitoring.

Monitoring shall be accurate, at a confidence level of 95 percent, to within plus or minus 25 percent for airborne concentrations of BD at or above the 1 ppm TWA limit and to within plus or minus 35 percent for airborne concentrations of BD at or above the action level of 0.5 ppm and below the 1 ppm TWA limit.

(g) Employee notification of monitoring results.

(i) The employer shall, within 5 business days after the receipt of the results of any monitoring performed under this section, notify the affected employees of these results in writing either individually or by posting of results in an appropriate location that is accessible to affected employees.

(ii) The employer shall, within 15 business days after receipt of any monitoring performed under this section indicating the 8-hour TWA or STEL has been exceeded, provide the affected employees, in writing, with information on the corrective action being taken by the employer to reduce employee exposure to or below the 8-hour TWA or STEL and the schedule for completion of this action.

(h) Observation of monitoring.

(i) Employee observation. The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to BD conducted in accordance with this section.

(ii) Observation procedures. When observation of the monitoring of employee exposure to BD requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the observer at no cost with protective clothing and equipment, and shall ensure that the observer uses this equipment and complies with all other applicable safety and health procedures.

(5) **Regulated areas.**

(a) The employer shall establish a regulated area wherever occupational exposures to airborne concentrations of BD exceed or can reasonably be expected to exceed the permissible exposure limits, either the 8-hr TWA or the STEL.

(b) Access to regulated areas shall be limited to authorized persons.

(c) Regulated areas shall be demarcated from the rest of the workplace in any manner that minimizes the number of employees exposed to BD within the regulated area.

(d) An employer at a multi-employer worksite who establishes a regulated area shall communicate the access restrictions and locations of these areas to other employers with work operations at that worksite whose employees may have access to these areas.

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(6) **Methods of compliance.**

(a) Engineering controls and work-practices.

(i) The employer shall institute engineering controls and work-practices to reduce and maintain employee exposure to or below the PELs, except to the extent that the employer can establish that these controls are not feasible or where subsection (8)(a)(i) of this section applies.

(ii) Wherever the feasible engineering controls and work-practices which can be instituted are not sufficient to reduce employee exposure to or below the 8-hour TWA or STEL, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of subsection (8) of this section.

(b) Compliance plan.

(i) Where any exposures are over the PELs, the employer shall establish and implement a written plan to reduce employee exposure to or below the PELs primarily by means of engineering and work-practice controls, as required by (a) of this subsection, and by the use of respiratory protection where required or permitted under this section. No compliance plan is required if all exposures are under the PELs.

(ii) The written compliance plan shall include a schedule for the development and implementation of the engineering controls and work-practice controls including periodic leak detection surveys.

(iii) Copies of the compliance plan required in (b) of this subsection shall be furnished upon request for examination and copying to the director, affected employees and designated employee representatives. Such plans shall be reviewed at least every 12 months, and shall be updated as necessary to reflect significant changes in the status of the employer's compliance program.

(iv) The employer shall not implement a schedule of employee rotation as a means of compliance with the PELs.

(7) **Exposure goal program.**

(a) For those operations and job classifications where employee exposures are greater than the action level, in addition to compliance with the PELs, the employer shall have an exposure goal program that is intended to limit employee exposures to below the action level during normal operations.

(b) Written plans for the exposure goal program shall be furnished upon request for examination and copying to the director, affected employees and designated employee representatives.

(c) Such plans shall be updated as necessary to reflect significant changes in the status of the exposure goal program.

(d) Respirator use is not required in the exposure goal program.

(e) The exposure goal program shall include the following items unless the employer can demonstrate that the item is not feasible, will have no significant effect in reducing employee exposures, or is not necessary to achieve exposures below the action level:

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(i) A leak prevention, detection, and repair program.

(ii) A program for maintaining the effectiveness of local exhaust ventilation systems.

(iii) The use of pump exposure control technology such as, but not limited to, mechanical double-sealed or seal-less pumps.

(iv) Gauging devices designed to limit employee exposure, such as magnetic gauges on rail cars.

(v) Unloading devices designed to limit employee exposure, such as a vapor return system.

(vi) A program to maintain BD concentration below the action level in control rooms by use of engineering controls.

(8) **Respiratory protection.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls;

(ii) Nonroutine work operations that are performed infrequently and for which exposures are limited in duration;

(iii) Work operations for which feasible engineering controls and work-practice controls are not yet sufficient to reduce employee exposures to or below the PELs;

(iv) Emergencies.

(b) Respirator program.

(i) The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1), 296-62-07131(4)(b)(i) and (ii), and 296-62-07150 through 296-62-07156).

(ii) If air-purifying respirators are used, the employer must replace the air-purifying filter elements according to the replacement schedule set for the class of respirators listed in Table 1 of this section, and at the beginning of each work shift.

(iii) Instead of using the replacement schedule listed in Table 1 of this section, the employer may replace cartridges or canisters at 90% of their expiration service life, provided the employer:

(A) Demonstrates that employees will be adequately protected by this procedure;

(B) Uses BD breakthrough data for this purpose that have been derived from tests conducted under worst-case conditions of humidity, temperature, and air-flow rate through the filter element, and the employer also describes the data supporting the cartridge-or canister-change schedule, as well as the basis for using the data in the employer's respirator program.

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(iv) A label must be attached to each filter element to indicate the date and time it is first installed on the respirator.

(v) If NIOSH approves and end-of-service-life indicator (ESLI) for an air-purifying filter element, the element may be used until the ESLI shows no further useful service life or until the element is replaced at the beginning of the next work shift, whichever occurs first.

(vi) Regardless of the air-purifying element used, if an employee detects the odor of BD, the employer must replace the air-purifying element immediately.

(c) Respirator selection.

(i) The employer must select appropriate respirators from Table 1 of this section.

Table 1. - Minimum Requirements for Respiratory Protection for Airborne BD

Concentration of Airborne BD (ppm) Or condition of use	Minimum required respirator
Less than or equal to 5 ppm(5 times PEL)	(a) Air-purifying half-mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 4 hours.
Less than or equal to 10 ppm (10 times PEL)	(a) Air-purifying half-mask or full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 3 hours.
Less than or equal to 25 ppm(25 times PEL)	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 2 hours. (b) Any powered air-purifying respirator equipped with approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every 2 hours.
	(c) Continuous-flow supplied air respirator equipped with a hood or helmet.
Less than or equal to 50 ppm(50 times PEL)	(a) Air-purifying full facepiece respirator equipped with approved BD or organic vapor cartridges or canisters Cartridge s or canisters shall be replaced every 1 hour. (b) Powered air purifying respirator equipped with a tight-fitting facepiece and an approved BD or organic vapor cartridges. PAPR cartridges shall be replaced every 1 hour.
Less than or equal to 1,000 ppm (1,000 times PEL)	(a) Supplied air respirator equipped with a half mask or full facepiece and operated in pressure-demand mode or other positive-pressure mode.

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Greater than 1,000 ppm	(a)	Self- contained breathing unknown concentration, or apparatus equipped with a fire fighting full facepiece and operated in a pressure-demand or other positive pressure mode.
	(b)	Any supplied air respirator equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode.
Escape from IDLH Conditions	(a)	Any positive-pressure self-contained breathing apparatus with an appropriate service life.
	(b)	Any air-purifying full facepiece respirator equipped with a front or back mounted BD or organic vapor canister.

Notes: Respirators approved for use in higher concentrations are permitted to be used in lower concentrations. Full facepiece is required when eye irritation is anticipated.

(ii) Air-purifying respirators must have filter elements certified by NIOSH for organic vapor or BD.

(iii) When an employee whose job requires the use of a respirator cannot use a negative-pressure respirator, the employer must provide the employee with a respirator that has less breathing resistance than the negative-pressure respirator, such as a powered air-purifying respirator or supplied-air respirator, when the employee is able to use it and if it provides the employee adequate protection.

(9) **Protective clothing and equipment.** Where appropriate to prevent eye contact and limit dermal exposure to BD, the employer shall provide protective clothing and equipment at no cost to the employee and shall ensure its use. Eye and face protection shall meet the requirements of WAC 296-800-160.

(10) **Emergency situations.** Written plan. A written plan for emergency situations shall be developed, or an existing plan shall be modified, to contain the applicable elements specified in WAC 296-24-567, Employee emergency plans and fire prevention plans, and in WAC 296-62-3112, hazardous waste operations and emergency responses, for each workplace where there is a possibility of an emergency.

(11) **Medical screening and surveillance.**

(a) Employees covered. The employer shall institute a medical screening and surveillance program as specified in this subsection for:

(i) Each employee with exposure to BD at concentrations at or above the action level on 30 or more days or for employees who have or may have exposure to BD at or above the PELs on 10 or more days a year;

(ii) Employers (including successor owners) shall continue to provide medical screening and surveillance for employees, even after transfer to a non-BD exposed job and regardless of when the employee is transferred, whose work histories suggest exposure to BD:

(A) At or above the PELs on 30 or more days a year for 10 or more years;

(B) At or above the action level on 60 or more days a year for 10 or more years; or

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(C) Above 10 ppm on 30 or more days in any past year; and

(iii) Each employee exposed to BD following an emergency situation.

(b) Program administration.

(i) The employer shall ensure that the health questionnaire, physical examination and medical procedures are provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(ii) Physical examinations, health questionnaires, and medical procedures shall be performed or administered by a physician or other licensed health care professional.

(iii) Laboratory tests shall be conducted by an accredited laboratory.

(c) Frequency of medical screening activities. The employer shall make medical screening available on the following schedule:

(i) For each employee covered under (a)(i) and (ii) of this subsection, a health questionnaire and complete blood count (CBC) with differential and platelet count every year, and a physical examination as specified below:

(A) An initial physical examination that meets the requirements of this rule, if twelve months or more have elapsed since the last physical examination conducted as part of a medical screening program for BD exposure;

(B) Before assumption of duties by the employee in a job with BD exposure;

(C) Every 3 years after the initial physical examination;

(D) At the discretion of the physician or other licensed health care professional reviewing the annual health questionnaire and CBC;

(E) At the time of employee reassignment to an area where exposure to BD is below the action level, if the employee's past exposure history does not meet the criteria of (a)(ii) of this subsection for continued coverage in the screening and surveillance program, and if twelve months or more have elapsed since the last physical examination; and

(F) At termination of employment if twelve months or more have elapsed since the last physical examination.

(ii) Following an emergency situation, medical screening shall be conducted as quickly as possible, but not later than 48 hours after the exposure.

(iii) For each employee who must wear a respirator, physical ability to perform the work and use the respirator must be determined as required by WAC 296-62-071.

(d) Content of medical screening.

(i) Medical screening for employees covered by (a)(i) and (ii) of this subsection shall include:

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(A) A baseline health questionnaire that includes a comprehensive occupational and health history and is updated annually. Particular emphasis shall be placed on the hematopoietic and reticuloendothelial systems, including exposure to chemicals, in addition to BD, that may have an adverse effect on these systems, the presence of signs and symptoms that might be related to disorders of these systems, and any other information determined by the examining physician or other licensed health care professional to be necessary to evaluate whether the employee is at increased risk of material impairment of health from BD exposure. Health questionnaires shall consist of the sample forms in Appendix C to this section, or be equivalent to those samples;

(B) A complete physical examination, with special emphasis on the liver, spleen, lymph nodes, and skin;

(C) A CBC; and

(D) Any other test which the examining physician or other licensed health care professional deems necessary to evaluate whether the employee may be at increased risk from exposure to BD.

(ii) Medical screening for employees exposed to BD in an emergency situation shall focus on the acute effects of BD exposure and at a minimum include: A CBC within 48 hours of the exposure and then monthly for three months; and a physical examination if the employee reports irritation of the eyes, nose, throat, lungs, or skin, blurred vision, coughing, drowsiness, nausea, or headache. Continued employee participation in the medical screening and surveillance program, beyond these minimum requirements, shall be at the discretion of the physician or other licensed health care professional.

(e) Additional medical evaluations and referrals.

(i) Where the results of medical screening indicate abnormalities of the hematopoietic or reticuloendothelial systems, for which a nonoccupational cause is not readily apparent, the examining physician or other licensed health care professional shall refer the employee to an appropriate specialist for further evaluation and shall make available to the specialist the results of the medical screening.

(ii) The specialist to whom the employee is referred under this subsection shall determine the appropriate content for the medical evaluation, e.g., examinations, diagnostic tests and procedures, etc.

(f) Information provided to the physician or other licensed health care professional. The employer shall provide the following information to the examining physician or other licensed health care professional involved in the evaluation:

(i) A copy of this section including its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's BD exposure;

(iii) The employee's actual or representative BD exposure level during employment tenure, including exposure incurred in an emergency situation;

(iv) A description of pertinent personal protective equipment used or to be used; and

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(v) Information, when available, from previous employment-related medical evaluations of the affected employee which is not otherwise available to the physician or other licensed health care professional or the specialist.

(g) The written medical opinion.

(i) For each medical evaluation required by this section, the employer shall ensure that the physician or other licensed health care professional produces a written opinion and provides a copy to the employer and the employee within 15 business days of the evaluation. The written opinion shall be limited to the following information:

(A) The occupationally pertinent results of the medical evaluation;

(B) A medical opinion concerning whether the employee has any detected medical conditions which would place the employee's health at increased risk of material impairment from exposure to BD;

(C) Any recommended limitations upon the employee's exposure to BD; and

(D) A statement that the employee has been informed of the results of the medical evaluation and any medical conditions resulting from BD exposure that require further explanation or treatment.

(ii) The written medical opinion provided to the employer shall not reveal specific records, findings, and diagnoses that have no bearing on the employee's ability to work with BD.

Note: This provision does not negate the ethical obligation of the physician or other licensed health care professional to transmit any other adverse findings directly to the employer.

(h) Medical surveillance.

(i) The employer shall ensure that information obtained from the medical screening program activities is aggregated (with all personal identifiers removed) and periodically reviewed, to ascertain whether the health of the employee population of that employer is adversely affected by exposure to BD.

(ii) Information learned from medical surveillance activities must be disseminated to covered employees, as defined in (a) of this subsection, in a manner that ensures the confidentiality of individual medical information.

(12) **Communication of BD hazards to employees.**

(a) Hazard communication. The employer shall communicate the hazards associated with BD exposure in accordance with the requirements of the chemical hazard communication standard, WAC 296-800-170.

(b) Employee information and training.

(i) The employer shall provide all employees exposed to BD with information and training in accordance with the requirements of the chemical hazard communication standard, WAC 296-800-170.

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(ii) The employer shall institute a training program for all employees who are potentially exposed to BD at or above the action level or the STEL, ensure employee participation in the program and maintain a record of the contents of such program.

(iii) Training shall be provided prior to or at the time of initial assignment to a job potentially involving exposure to BD at or above the action level or STEL and at least annually thereafter.

(iv) The training program shall be conducted in a manner that the employee is able to understand. The employer shall ensure that each employee exposed to BD over the action level or STEL is informed of the following:

(A) The health hazards associated with BD exposure, and the purpose and a description of the medical screening and surveillance program required by this section;

(B) The quantity, location, manner of use, release, and storage of BD and the specific operations that could result in exposure to BD, especially exposures above the PEL or STEL;

(C) The engineering controls and work-practices associated with the employee's job assignment, and emergency procedures and personal protective equipment;

(D) The measures employees can take to protect themselves from exposure to BD;

(E) The contents of this standard and its appendices; and

(F) The right of each employee exposed to BD at or above the action level or STEL to obtain:

(I) Medical examinations as required by subsection (10) of this section at no cost to the employee;

(II) The employee's medical records required to be maintained by subsection (13)(c) of this section; and

(III) All air monitoring results representing the employee's exposure to BD and required to be kept by subsection (13)(b) of this section.

(c) Access to information and training materials.

(i) The employer shall make a copy of this standard and its appendices readily available without cost to all affected employees and their designated representatives and shall provide a copy if requested.

(ii) The employer shall provide to the director, or the designated employee representatives, upon request, all materials relating to the employee information and the training program.

(13) **Recordkeeping.**

(a) Objective data for exemption from initial monitoring.

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(i) Where the processing, use, or handling of products or streams made from or containing BD are exempted from other requirements of this section under subsection (1)(b) of this section, or where objective data have been relied on in lieu of initial monitoring under subsection (4)(b)(ii) of this section, the employer shall establish and maintain a record of the objective data reasonably relied upon in support of the exemption.

(ii) This record shall include at least the following information:

(A) The product or activity qualifying for exemption;

(B) The source of the objective data;

(C) The testing protocol, results of testing, and analysis of the material for the release of BD;

(D) A description of the operation exempted and how the data support the exemption; and

(E) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(b) Exposure measurements.

(i) The employer shall establish and maintain an accurate record of all measurements taken to monitor employee exposure to BD as prescribed in subsection (4) of this section.

(ii) The record shall include at least the following information:

(A) The date of measurement;

(B) The operation involving exposure to BD which is being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy;

(D) Number, duration, and results of samples taken;

(E) Type of protective devices worn, if any;

(F) Name, Social Security number and exposure of the employees whose exposures are represented; and

(G) The written corrective action and the schedule for completion of this action required by subsection (4)(g)(ii) of this section.

(iii) The employer shall maintain this record for at least 30 years in accordance with WAC 296-62-052.

(c) Medical screening and surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical screening and surveillance under this section.

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(ii) The record shall include at least the following information:

(A) The name and Social Security number of the employee;

(B) Physician's or other licensed health care professional's written opinions as described in subsection (11)(e) of this section;

(C) A copy of the information provided to the physician or other licensed health care professional as required by subsections (11)(e) of this section.

(iii) Medical screening and surveillance records shall be maintained for each employee for the duration of employment plus 30 years, in accordance with WAC 296-62-052.

(d) Availability.

(i) The employer, upon written request, shall make all records required to be maintained by this section available for examination and copying to the director.

(ii) Access to records required to be maintained by (a) and (b) of this subsection shall be granted in accordance with WAC 296-62-05209.

(e) Transfer of records.

(i) Whenever the employer ceases to do business, the employer shall transfer records required by this section to the successor employer. The successor employer shall receive and maintain these records. If there is no successor employer, the employer shall notify the director, at least three months prior to disposal, and transmit them to the director if requested by the director within that period.

(ii) The employer shall transfer medical and exposure records as set forth in WAC 296-62-05215.

(14) **Dates.**

(a) Effective date. This section shall become effective (day,month), 1997.

(b) Start-up dates.

(i) The initial monitoring required under subsection (4)(b) of this section shall be completed immediately or within sixty days of the introduction of BD into the workplace.

(ii) The requirements of subsections (3) through (13) of this section, including feasible work-practice controls but not including engineering controls specified in subsection (6)(a) of this section, shall be complied with immediately.

(iii) Engineering controls specified by subsection (6)(a) of this section shall be implemented by February 4, 1999, and the exposure goal program specified in subsection (7) of this section shall be implemented by February 4, 2000.

(15) **Appendices.** Appendices A, B, C, D, and F to this section are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

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Appendix A. Substance Safety Data Sheet For 1,3-Butadiene (Non-Mandatory)

(1) **Substance Identification.**

(a) Substance: 1,3-Butadiene ($CH_2 = CHCH = CH_2$).

(b) Synonyms: 1,3-Butadiene (BD); butadiene; biethylene; bi-vinyl; divinyl; butadiene-1,3; buta-1,3-diene; erythrene; NCI-C50602; CAS-106-99-0.

(c) BD can be found as a gas or liquid.

(d) BD is used in production of styrene-butadiene rubber and polybutadiene rubber for the tire industry. Other uses include copolymer latexes for carpet backing and paper coating, as well as resins and polymers for pipes and automobile and appliance parts. It is also used as an intermediate in the production of such chemicals as fungicides.

(e) Appearance and odor: BD is a colorless, non-corrosive, flammable gas with a mild aromatic odor at standard ambient temperature and pressure.

(f) Permissible exposure: Exposure may not exceed 1 part BD per million parts of air averaged over the 8-hour workday, nor may short-term exposure exceed 5 parts of BD per million parts of air averaged over any 15-minute period in the 8-hour workday.

(2) **Health Hazard Data.**

(a) BD can affect the body if the gas is inhaled or if the liquid form, which is very cold (cryogenic), comes in contact with the eyes or skin.

(b) Effects of overexposure: Breathing very high levels of BD for a short time can cause central nervous system effects, blurred vision, nausea, fatigue, headache, decreased blood pressure and pulse rate, and unconsciousness. There are no recorded cases of accidental exposures at high levels that have caused death in humans, but this could occur. Breathing lower levels of BD may cause irritation of the eyes, nose, and throat. Skin contact with liquefied BD can cause irritation and frostbite.

(c) Long-term (chronic) exposure: BD has been found to be a potent carcinogen in rodents, inducing neoplastic lesions at multiple target sites in mice and rats. A recent study of BD-exposed workers showed that exposed workers have an increased risk of developing leukemia. The risk of leukemia increases with increased exposure to BD. OSHA has concluded that there is strong evidence that workplace exposure to BD poses an increased risk of death from cancers of the lymphohematopoietic system.

(d) Reporting signs and symptoms: You should inform your supervisor if you develop any of these signs or symptoms and suspect that they are caused by exposure to BD.

(3) **Emergency First Aid Procedures.**

In the event of an emergency, follow the emergency plan and procedures designated for your work area. If you have been trained in first aid procedures, provide the necessary first aid measures. If necessary, call for additional assistance from co-workers and emergency medical personnel.

(a) Eye and Skin Exposures: If there is a potential that liquefied BD can come in contact with eye or skin, face shields and skin protective equipment must be provided and used. If liquefied BD comes in contact with the eye, immediately flush the eyes with large amounts of water,

occasionally lifting the lower and the upper lids. Flush repeatedly. Get medical attention immediately. Contact lenses should not be worn when working with this chemical. In the event of skin contact, which can cause frostbite, remove any contaminated clothing and flush the affected area repeatedly with large amounts of tepid water.

(b) Breathing: If a person breathes in large amounts of BD, move the exposed person to fresh air at once. If breathing has stopped, begin cardiopulmonary resuscitation (CPR) if you have been trained in this procedure. Keep the affected person warm and at rest. Get medical attention immediately.

(c) Rescue: Move the affected person from the hazardous exposure. If the exposed person has been overcome, call for help and begin emergency rescue procedures. Use extreme caution so that you do not become a casualty. Understand the plant's emergency rescue procedures and know the locations of rescue equipment before the need arises.

(4) **Respirators and Protective Clothing.**

(a) Respirators: Good industrial hygiene practices recommend that engineering and work-practice controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work-practice controls are not technically feasible, when such controls are in the process of being installed, or when these controls fail and need to be supplemented or during brief, non-routine, intermittent exposure. Respirators may also be used in situations involving non-routine work operations which are performed infrequently and in which exposures are limited in duration, and in emergency situations. In some instances cartridge respirator use is allowed, but only with strict time constraints. For example, at exposure below 5 ppm BD, a cartridge (or canister) respirator, either full or half face, may be used, but the cartridge must be replaced at least every 4 hours, and it must be replaced every 3 hours when the exposure is between 5 and 10 ppm.

If the use of respirators is necessary, the only respirators permitted are those that have been approved by the National Institute for Occupational Safety and Health (NIOSH). In addition to respirator selection, a complete respiratory protection program must be instituted which includes regular training, maintenance, fit testing, inspection, cleaning, and evaluation of respirators. If you can smell BD while wearing a respirator, proceed immediately to fresh air, and change cartridge (or canister) before re-entering an area where there is BD exposure. If you experience difficulty in breathing while wearing a respirator, tell your supervisor.

(b) Protective Clothing: Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent the skin from becoming frozen by contact with liquefied BD (or a vessel containing liquid BD).

Employees should be provided with and required to use splash-proof safety goggles where liquefied BD may contact the eyes.

(5) **Precautions for Safe Use, Handling, and Storage.**

(a) Fire and Explosion Hazards: BD is a flammable gas and can easily form explosive mixtures in air. It has a lower explosive limit of 2%, and an upper explosive limit of 11.5%. It has an autoignition temperature of 420 deg. C (788 deg. F). Its vapor is heavier than air (vapor density, 1.9) and may travel a considerable distance to a source of ignition and flash back. Usually it contains inhibitors to prevent self-polymerization (which is accompanied by evolution of heat)

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and to prevent formation of explosive peroxides. At elevated temperatures, such as in fire conditions, polymerization may take place. If the polymerization takes place in a container, there is a possibility of violent rupture of the container.

(b) Hazard: Slightly toxic. Slight respiratory irritant. Direct contact of liquefied BD on skin may cause freeze burns and frostbite.

(c) Storage: Protect against physical damage to BD containers. Outside or detached storage of BD containers is preferred. Inside storage should be in a cool, dry, well-ventilated, noncombustible location, away from all possible sources of ignition. Store cylinders vertically and do not stack. Do not store with oxidizing material.

(d) Usual Shipping Containers: Liquefied BD is contained in steel pressure apparatus.

(e) Electrical Equipment: Electrical installations in Class I hazardous locations, as defined in Article 500 of the National Electrical Code, should be in accordance with Article 501 of the Code. If explosion-proof electrical equipment is necessary, it shall be suitable for use in Group B. Group D equipment may be used if such equipment is isolated in accordance with Section 501-5(a) by sealing all conduit 1/2-inch size or larger. See Venting of Deflagrations (NFPA No. 68, 1994), National Electrical Code (NFPA No. 70, 1996), Static Electricity (NFPA No. 77, 1993), Lightning Protection Systems (NFPA No. 780, 1995), and Fire Hazard Properties of Flammable Liquids, Gases and Volatile Solids (NFPA No. 325, 1994).

(f) Fire Fighting: Stop flow of gas. Use water to keep fire-exposed containers cool. Fire extinguishers and quick drenching facilities must be readily available, and you should know where they are and how to operate them.

(g) Spill and Leak: Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until clean-up has been completed. If BD is spilled or leaked, the following steps should be taken:

(i) Eliminate all ignition sources.

(ii) Ventilate area of spill or leak.

(iii) If in liquid form, for small quantities, allow to evaporate in a safe manner.

(iv) Stop or control the leak if this can be done without risk. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place and repair the leak or allow the cylinder to empty.

(h) Disposal: This substance, when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR part 261). It is listed as hazardous waste number D001 due to its ignitability. The transportation, storage, treatment, and disposal of this waste material must be conducted in compliance with 40 CFR parts 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulation of any additional requirements as these may be more restrictive than federal laws and regulation.

(i) You should not keep food, beverages, or smoking materials in areas where there is BD exposure, nor should you eat or drink in such areas.

(j) Ask your supervisor where BD is used in your work area and ask for any additional plant safety and health rules.

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(6) **Medical Requirements.**

Your employer is required to offer you the opportunity to participate in a medical screening and surveillance program if you are exposed to BD at concentrations exceeding the action level (0.5 ppm BD as an 8-hour TWA) on 30 days or more a year, or at or above the 8-hr TWA (1 ppm) or STEL (5 ppm for 15 minutes) on 10 days or more a year. Exposure for any part of a day counts. If you have had exposure to BD in the past, but have been transferred to another job, you may still be eligible to participate in the medical screening and surveillance program.

The WISHA rule specifies the past exposures that would qualify you for participation in the program. These past exposure are work histories that suggest the following:

(a) That you have been exposed at or above the PELs on 30 days a year for 10 or more years;

(b) That you have been exposed at or above the action level on 60 days a year for 10 or more years; or

(c) That you have been exposed above 10 ppm on 30 days in any past year.

Additionally, if you are exposed to BD in an emergency situation, you are eligible for a medical examination within 48 hours. The basic medical screening program includes a health questionnaire, physical examination, and blood test. These medical evaluations must be offered to you at a reasonable time and place, and without cost or loss of pay.

(7) **Observation of Monitoring.**

Your employer is required to perform measurements that are representative of your exposure to BD and you or your designated representative are entitled to observe the monitoring procedure. You are entitled to observe the steps taken in the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you or your representative must also be provided with, and must wear, the protective clothing and equipment.

(8) **Access to Information.**

(a) Each year, your employer is required to inform you of the information contained in this appendix. In addition, your employer must instruct you in the proper work-practices for using BD, emergency procedures, and the correct use of protective equipment.

(b) Your employer is required to determine whether you are being exposed to BD. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being overexposed, he or she is required to inform you of the actions which are being taken to reduce your exposure to within permissible exposure limits and of the schedule to implement these actions.

(c) Your employer is required to keep records of your exposures and medical examinations. These records must be kept by the employer for at least thirty (30) years.

(d) Your employer is required to release your exposure and medical records to you or your representative upon your request.

[Statutory Authority: Chapter 49.17 RCW. 97-19-014 (Order 97-07), § 296-62-7460, filed 10/05/97, effective 11/05/97.]

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Appendix B. Substance Technical Guidelines for 1,3-Butadiene (Non-Mandatory)

(1) **Physical and Chemical Data.**

(a) Substance identification:

(i) Synonyms: 1,3-Butadiene (BD); butadiene; biethylene; bivinyl; divinyl; butadiene-1,3; buta-1,3-diene; erythrene; NCI-C50620; CAS-106-99-0.

(ii) Formula: (CH_2:CHCH:CH_2).

(iii) Molecular weight: 54.1.

(b) Physical data:

(i) Boiling point (760 mm Hg): -4.7 deg. C (23.5 deg. F).

(ii) Specific gravity (water = 1): 0.62 at 20 deg. C (68 deg. F).

(iii) Vapor density (air = 1 at boiling point of BD): 1.87.

(iv) Vapor pressure at 20 deg. C (68 deg. F): 910 mm Hg.

(v) Solubility in water, g/100 g water at 20 deg. C (68 deg. F): 0.05.

(vi) Appearance and odor: Colorless, flammable gas with a mildly aromatic odor. Liquefied BD is a colorless liquid with a mildly aromatic odor.

(2) **Fire, Explosion, and Reactivity Hazard Data.**

(a) Fire:

(i) Flash point: -76 deg. C (-105 deg. F) for take out; liquefied BD; Not applicable to BD gas.

(ii) Stability: A stabilizer is added to the monomer to inhibit formation of polymer during storage. Forms explosive peroxides in air in absence of inhibitor.

(iii) Flammable limits in air, percent by volume: Lower: 2.0; Upper: 11.5.

(iv) Extinguishing media: Carbon dioxide for small fires, polymer or alcohol foams for large fires.

(v) Special fire fighting procedures: Fight fire from protected location or maximum possible distance. Stop flow of gas before extinguishing fire. Use water spray to keep fire-exposed cylinders cool.

(vi) Unusual fire and explosion hazards: BD vapors are heavier than air and may travel to a source of ignition and flash back. Closed containers may rupture violently when heated.

(vii) For purposes of compliance with the requirements of WAC 296-24-330, BD is classified as a flammable gas. For example, 7,500 ppm, approximately one-fourth of the lower flammable limit, would be considered to pose a potential fire and explosion hazard.

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(viii) For purposes of compliance with WAC 296-24-585, BD is classified as a Class B fire hazard.

(ix) For purposes of compliance with WAC 296-24-956 and 296-800-280, locations classified as hazardous due to the presence of BD shall be Class I.

(b) Reactivity:

(i) Conditions contributing to instability: Heat. Peroxides are formed when inhibitor concentration is not maintained at proper level. At elevated temperatures, such as in fire conditions, polymerization may take place.

(ii) Incompatibilities: Contact with strong oxidizing agents may cause fires and explosions. The contacting of crude BD (not BD monomer) with copper and copper alloys may cause formations of explosive copper compounds.

(iii) Hazardous decomposition products: Toxic gases (such as carbon monoxide) may be released in a fire involving BD.

(iv) Special precautions: BD will attack some forms of plastics, rubber, and coatings. BD in storage should be checked for proper inhibitor content, for self-polymerization, and for formation of peroxides when in contact with air and iron. Piping carrying BD may become plugged by formation of rubbery polymer.

(c) Warning Properties:

(i) Odor Threshold: An odor threshold of 0.45 ppm has been reported in The American Industrial Hygiene Association (AIHA) Report, Odor Thresholds for Chemicals with Established Occupational Health Standards. (Ex. 32-28C).

(ii) Eye Irritation Level: Workers exposed to vapors of BD (concentration or purity unspecified) have complained of irritation of eyes, nasal passages, throat, and lungs. Dogs and rabbits exposed experimentally to as much as 6700 ppm for 7 1/2 hours a day for 8 months have developed no histologically demonstrable abnormality of the eyes.

(iii) Evaluation of Warning Properties: Since the mean odor threshold is about half of the 1 ppm PEL, and more than 10-fold below the 5 ppm STEL, most wearers of air purifying respirators should still be able to detect breakthrough before a significant overexposure to BD occurs.

(3) **Spill, Leak, and Disposal Procedures.**

(a) Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed. If BD is spilled or leaked, the following steps should be taken:

(i) Eliminate all ignition sources.

(ii) Ventilate areas of spill or leak.

(iii) If in liquid form, for small quantities, allow to evaporate in a safe manner.

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(iv) Stop or control the leak if this can be done without risk. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place and repair the leak or allow the cylinder to empty.

(b) Disposal: This substance, when discarded or disposed of, is a hazardous waste according to Federal regulations (40 CFR part 261). It is listed by the EPA as hazardous waste number D001 due to its ignitability. The transportation, storage, treatment, and disposal of this waste material must be conducted in compliance with 40 CFR parts 262, 263, 264, 268 and 270. Disposal can occur only in properly permitted facilities. Check state and local regulations for any additional requirements because these may be more restrictive than federal laws and regulations.

(4) **Monitoring and Measurement Procedures.**

(a) Exposure above the Permissible Exposure Limit (8-hr TWA) or Short-Term Exposure Limit (STEL):

(i) 8-hr TWA exposure evaluation: Measurements taken for the purpose of determining employee exposure under this standard are best taken with consecutive samples covering the full shift. Air samples must be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

(ii) STEL exposure evaluation: Measurements must represent 15 minute exposures associated with operations most likely to exceed the STEL in each job and on each shift.

(iii) Monitoring frequencies: Table 1 gives various exposure scenarios and their required monitoring frequencies, as required by the final standard for occupational exposure to butadiene.

Table 1. - Five Exposure Scenarios and Their Associated Monitoring Frequencies

Action Level	8-hr TWA	STEL	Required Monitoring Activity
—*	—	—	No 8-hr TWA or STEL monitoring required.
+*	—	—	No STEL monitoring required. Monitor 8-hr
			TWA annually.
+	—	—	No STEL monitoring required. Periodic
			monitoring 8-hr TWA, in accordance with
			(4)(c)(iii).**
+	+	+	Periodic monitoring 8-hr TWA, in accordance
			with (4)(c)(iii)**. Periodic monitoring STEL
			in accordance with (4)(c)(iii).
+	–	+	Periodic monitoring STEL, in accordance with (4)(c)(iii). Monitor 8-hr TWA annually.

Footnote(*) *Exposure Scenario, Limit Exceeded: + = Yes, - = No.*

Footnote(**) *The employer may decrease the frequency of exposure monitoring to annually when at least 2 consecutive measurements taken at least 7 days apart show exposures to be below the 8-hr TWA, but at or above the action level.*

(iv) Monitoring techniques: Appendix D describes the validated method of sampling and analysis which has been tested by OSHA for use with BD. The employer has the obligation of selecting a monitoring method which meets the accuracy and precision requirements of the standard under his or her unique field conditions. The standard requires that the method of monitoring must be accurate, to a 95 percent confidence

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level, to plus or minus 25 percent for concentrations of BD at or above 1 ppm, and to plus or minus 35 percent for concentrations below 1 ppm.

(5) **Personal Protective Equipment.**

(a) Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent the skin from becoming frozen from contact with liquid BD.

(b) Any clothing which becomes wet with liquid BD should be removed immediately and not re-worn until the butadiene has evaporated.

(c) Employees should be provided with and required to use splash proof safety goggles where liquid BD may contact the eyes.

(6) **Housekeeping and Hygiene Facilities.**

For purposes of complying with WAC 296-24-120, 296-800-220 and 296-800-230, the following items should be emphasized:

(a) The workplace should be kept clean, orderly, and in a sanitary condition.

(b) Adequate washing facilities with hot and cold water are to be provided and maintained in a sanitary condition.

(7) **Additional Precautions.**

(a) Store BD in tightly closed containers in a cool, well-ventilated area and take all necessary precautions to avoid any explosion hazard.

(b) Non-sparking tools must be used to open and close metal containers. These containers must be effectively grounded.

(c) Do not incinerate BD cartridges, tanks or other containers.

(d) Employers must advise employees of all areas and operations where exposure to BD might occur.

[Statutory Authority: Statutory Authority: Chapter 49.17 RCW. 97-19-014 (Order 97-07), § 296-62-7460, filed 10/05/97, effective 11/05/97.]

Appendix C. Medical Screening and Surveillance for 1,3-Butadiene (Non-Mandatory)

(1) **Basis for Medical Screening and Surveillance Requirements.**

(a) Route of Entry Inhalation.

(b) Toxicology.

Inhalation of BD has been linked to an increased risk of cancer, damage to the reproductive organs, and fetotoxicity. Butadiene can be converted via oxidation to epoxybutene and diepoxybutane, two genotoxic metabolites that may play a role in the expression of BD's toxic effects. BD has been tested for carcinogenicity in mice and rats. Both species responded to BD exposure by developing cancer at multiple primary organ sites. Early deaths in mice were caused by malignant lymphomas, primarily lymphocytic type, originating in the thymus.

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Mice exposed to BD have developed ovarian or testicular atrophy. Sperm head morphology tests also revealed abnormal sperm in mice exposed to BD; lethal mutations were found in a dominant lethal test. In light of these results in animals, the possibility that BD may adversely affect the reproductive systems of male and female workers must be considered.

Additionally, anemia has been observed in animals exposed to butadiene. In some cases, this anemia appeared to be a primary response to exposure; in other cases, it may have been secondary to a neoplastic response.

(c) Epidemiology.

Epidemiologic evidence demonstrates that BD exposure poses an increased risk of leukemia. Mild alterations of hematologic parameters have also been observed in synthetic rubber workers exposed to BD.

(2) **Potential Adverse Health Effects.**

(a) Acute.

Skin contact with liquid BD causes characteristic burns or frostbite. BD in gaseous form can irritate the eyes, nasal passages, throat, and lungs. Blurred vision, coughing, and drowsiness may also occur. Effects are mild at 2,000 ppm and pronounced at 8,000 ppm for exposures occurring over the full workshift.

At very high concentrations in air, BD is an anesthetic, causing narcosis, respiratory paralysis, unconsciousness, and death. Such concentrations are unlikely, however, except in an extreme emergency because BD poses an explosion hazard at these levels.

(b) Chronic.

The principal adverse health effects of concern are BD-induced lymphoma, leukemia and potential reproductive toxicity. Anemia and other changes in the peripheral blood cells may be indicators of excessive exposure to BD.

(c) Reproductive.

Workers may be concerned about the possibility that their BD exposure may be affecting their ability to procreate a healthy child. For workers with high exposures to BD, especially those who have experienced difficulties in conceiving, miscarriages, or stillbirths, appropriate medical and laboratory evaluation of fertility may be necessary to determine if BD is having any adverse effect on the reproductive system or on the health of the fetus.

(3) **Medical Screening Components At-A-Glance.**

(a) Health Questionnaire.

The most important goal of the health questionnaire is to elicit information from the worker regarding potential signs or symptoms generally related to leukemia or other blood abnormalities. Therefore, physicians or other licensed health care professionals should be aware of the presenting symptoms and signs of lymphohematopoietic

disorders and cancers, as well as the procedures necessary to confirm or exclude such diagnoses. Additionally, the health questionnaire will assist with the identification of workers at greatest risk of developing leukemia or adverse reproductive effects from their exposures to BD.

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Workers with a history of reproductive difficulties or a personal or family history of immune deficiency syndromes, blood dyscrasias, lymphoma, or leukemia, and those who are or have been exposed to medicinal drugs or chemicals known to affect the hematopoietic or lymphatic systems may be at higher risk from their exposure to BD. After the initial administration, the health questionnaire must be updated annually.

(b) Complete Blood Count (CBC).

The medical screening and surveillance program requires an annual CBC, with differential and platelet count, to be provided for each employee with BD exposure. This test is to be performed on a blood sample obtained by phlebotomy of the venous system or, if technically feasible, from a fingerstick sample of capillary blood. The sample is to be analyzed by an accredited laboratory.

Abnormalities in a CBC may be due to a number of different etiologies. The concern for workers exposed to BD includes, but is not limited to, timely identification of lymphohematopoietic cancers, such as leukemia and non-Hodgkin's lymphoma. Abnormalities of portions of the CBC are identified by comparing an individual's results to those of an established range of normal values for males and females. A substantial change in any individual employee's CBC may also be viewed as “abnormal” for that individual even if all measurements fall within the population-based range of normal values. It is suggested that a flowsheet for laboratory values be included in each employee's medical record so that comparisons and trends in annual CBCs can be easily made.

A determination of the clinical significance of an abnormal CBC shall be the responsibility of the examining physician, other licensed health care professional, or medical specialist to whom the employee is referred. Ideally, an abnormal CBC should be compared to previous CBC measurements for the same employee, when available. Clinical common sense may dictate that a CBC value that is very slightly outside the normal range does not warrant medical concern. A CBC abnormality may also be the result of a temporary physical stressor, such as a transient viral illness, blood donation, or menorrhagia, or laboratory error. In these cases, the CBC should be repeated in a timely fashion, i.e., within 6 weeks, to verify that return to the normal range has occurred. A clinically significant abnormal CBC should result in removal of the employee from further exposure to BD. Transfer of the employee to other work duties in a BD-free environment would be the preferred recommendation.

(c) Physical Examination.

The medical screening and surveillance program requires an initial physical examination for workers exposed to BD; this examination is repeated once every three years. The initial physical examination should assess each worker's baseline general health and rule out clinical signs of medical conditions that may be caused by or aggravated by occupational BD exposure. The physical examination should be directed at identification of signs of lymphohematopoietic disorders, including lymph node enlargement, splenomegaly, and hepatomegaly.

Repeated physical examinations should update objective clinical findings that could be indicative of interim development of a lymphohematopoietic disorder, such as lymphoma, leukemia, or other blood abnormality. Physical examinations may also be provided on an as needed basis in order to follow up on a positive answer on the health questionnaire, or in response to an abnormal CBC. Physical examination of workers who will no longer be working in jobs with BD exposure are intended to rule out lymphohematopoietic disorders.

The need for physical examinations for workers concerned about adverse reproductive effects from their exposure to BD should be identified by the physician or other licensed health care professional and provided accordingly. For these workers, such consultations and examinations may relate to developmental toxicity and reproductive capacity.

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Physical examination of workers acutely exposed to significant levels of BD should be especially directed at the respiratory system, eyes, sinuses, skin, nervous system, and any region associated with particular complaints. If the worker has received a severe acute exposure, hospitalization may be required to assure proper medical management. Since this type of exposure may place workers at greater risk of blood abnormalities, a CBC must be obtained within 48 hours and repeated at one, two, and three months.

[Statutory Authority: Chapter 49.17 RCW. 97-19-014 (Order 97-07), § 296-62-7460, filed 10/05/97, effective 11/05/97.]

Appendix D: Sampling and Analytical Method for 1,3-Butadiene (Non-Mandatory)

OSHA Method No.: 56.

Matrix: Air.

Target concentration: 1 ppm (2.21 mg/m^3).

Procedure: Air samples are collected by drawing known volumes of air through sampling tubes containing charcoal adsorbent which has been coated with 4-tert-butylcatechol. The samples are desorbed with carbon disulfide and then analyzed by gas chromatography using a flame ionization detector.

Recommended sampling rate and air volume: 0.05 L/min and 3 L.

Detection limit of the overall procedure: 90 ppb (200 ug/m^3) (based on 3 L air volume).

Reliable quantitation limit: 155 ppb (343 ug/m^3) (based on 3 L air volume).

Standard error of estimate at the target concentration: 6.5%.

Special requirements: The sampling tubes must be coated with 4-tert-butylcatechol. Collected samples should be stored in a freezer.

Status of method: A sampling and analytical method has been subjected to the established evaluation procedures of the Organic Methods Evaluation Branch, OSHA Analytical Laboratory, Salt Lake City, Utah 84165.

(1) **Background.**

This work was undertaken to develop a sampling and analytical procedure for BD at 1 ppm. The current method recommended by OSHA for collecting BD uses activated coconut shell charcoal as the sampling medium (Ref. 5.2). This method was found to be inadequate for use at low BD levels because of sample instability.

The stability of samples has been significantly improved through the use of a specially cleaned charcoal which is coated with 4-tert-butylcatechol (TBC). TBC is a polymerization inhibitor for BD (Ref. 5.3).

(a) Toxic effects.

Symptoms of human exposure to BD include irritation of the eyes, nose and throat. It can also cause coughing, drowsiness and fatigue. Dermatitis and frostbite can result from skin exposure to liquid BD. (Ref. 5.1)

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NIOSH recommends that BD be handled in the workplace as a potential occupational carcinogen. This recommendation is based on two inhalation studies that resulted in cancers at multiple sites in rats and in mice. BD has also demonstrated mutagenic activity in the presence of a liver microsomal activating system. It has also been reported to have adverse reproductive effects. (Ref. 5.1)

(b) Potential workplace exposure.

About 90% of the annual production of BD is used to manufacture styrene-butadiene rubber and Polybutadiene rubber. Other uses include: Polychloroprene rubber, acrylonitrile butadiene-stryene resins, nylon intermediates, styrene-butadiene latexes, butadiene polymers, thermoplastic elastomers, nitrile resins, methyl methacrylate-butadiene styrene resins and chemical intermediates. (Ref. 5.1)

(c) Physical properties (Ref. 5.1).

CAS No.:	106-99-0
Molecular weight:	54.1
Appearance:	Colorless gas
Boiling point:	-4.41 deg. C (760 mm Hg)
Freezing point:	-108.9 deg. C
Vapor pressure:	2 atm (a) 15.3 deg. C; 5 atm (a) 47 deg. C
Explosive limits:	2 to 11.5% (by volume in air)
Odor threshold:	0.45 ppm
Structural formula:	$H_2C:CHCH:CH_2$
Synonyms:	BD; biethylene; bivinyl; butadiene; divinyl; buta-1,3-diene; alpha-gamma-butadiene; erythrene; NCI-C50602; pyrrolylene; vinylethylene.

(d) Limit defining parameters.

The analyte air concentrations listed throughout this method are based on an air volume of 3 L and a desorption volume of 1 mL. Air concentrations listed in ppm are referenced to 25 deg. C and 760 mm Hg.

(e) Detection limit of the analytical procedure.

The detection limit of the analytical procedure was 304 pg per injection. This was the amount of BD which gave a response relative to the interferences present in a standard.

(f) Detection limit of the overall procedure.

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The detection limit of the overall procedure was 0.60 ug per sample (90 ppb or 200 ug/m^3). This amount was determined graphically. It was the amount of analyte which, when spiked on the sampling device, would allow recovery approximately equal to the detection limit of the analytical procedure.

(g) Reliable quantitation limit.

The reliable quantitation limit was 1.03 ug per sample (155 ppb or 343 ug/m^3). This was the smallest amount of analyte which could be quantitated within the limits of a recovery of at least 75% and a precision (+/- 1.96 SD) of +/- 25% or better.

(h) Sensitivity.(1)

Footnote(1) *The reliable quantitation limit and detection limits reported in the method are based upon optimization of the instrument for the smallest possible amount of analyte. When the target concentration of an analyte is exceptionally higher than these limits, they may not be attainable at the routine operation parameters.*

The sensitivity of the analytical procedure over a concentration range representing 0.6 to 2 times the target concentration, based on the recommended air volume, was 387 area units per ug/mL. This value was determined from the slope of the calibration curve. The sensitivity may vary with the particular instrument used in the analysis.

(i) Recovery.

The recovery of BD from samples used in storage tests remained above 77% when the samples were stored at ambient temperature and above 94% when the samples were stored at refrigerated temperature. These values were determined from regression lines which were calculated from the storage data. The recovery of the analyte from the collection device must be at least 75% following storage.

(j) Precision (analytical method only).

The pooled coefficient of variation obtained from replicate determinations of analytical standards over the range of 0.6 to 2 times the target concentration was 0.011.

(k) Precision (overall procedure).

The precision at the 95% confidence level for the refrigerated temperature storage test was +/- 12.7%. This value includes an additional +/- 5% for sampling error. The overall procedure must provide results at the target concentrations that are +/- 25% at the 95% confidence level.

(l) Reproducibility.

Samples collected from a controlled test atmosphere and a draft copy of this procedure were given to a chemist unassociated with this evaluation. The average recovery was 97.2% and the standard deviation was 6.2%.

(2) **Sampling procedure.**

(a) Apparatus. Samples are collected by use of a personal sampling pump that can be calibrated to within +/- 5% of the recommended 0.05 L/min sampling rate with the sampling tube in line.

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(b) Samples are collected with laboratory prepared sampling tubes. The sampling tube is constructed of silane-treated glass and is about 5-cm long. The ID is 4 mm and the OD is 6 mm. One end of the tube is tapered so that a glass wool end plug will hold the contents of the tube in place during sampling. The opening in the tapered end of the sampling tube is at least one-half the ID of the tube (2 mm). The other end of the sampling tube is open to its full 4-mm ID to facilitate packing of the tube. Both ends of the tube are fire-polished for safety. The tube is packed with 2 sections of pretreated charcoal which has been coated with TBC. The tube is packed with a 50-mg backup section, located nearest the tapered end, and with a 100-mg sampling section of charcoal. The two sections of coated adsorbent are separated and retained with small plugs of silanized glass wool. Following packing, the sampling tubes are sealed with two 7/32 inch OD plastic end caps.

Instructions for the pretreatment and coating of the charcoal are presented in Section 4.1 of this method.

(c) Reagents.

None required.

(d) Technique.

(i) Properly label the sampling tube before sampling and then remove the plastic end caps.

(ii) Attach the sampling tube to the pump using a section of flexible plastic tubing such that the larger front section of the sampling tube is exposed directly to the atmosphere. Do not place any tubing ahead of the sampling tube. The sampling tube should be attached in the worker's breathing zone in a vertical manner such that it does not impede work performance.

(iii) After sampling for the appropriate time, remove the sampling tube from the pump and then seal the tube with plastic end caps. Wrap the tube lengthwise.

(iv) Include at least one blank for each sampling set. The blank should be handled in the same manner as the samples with the exception that air is not drawn through it.

(v) List any potential interferences on the sample data sheet.

(vi) The samples require no special shipping precautions under normal conditions. The samples should be refrigerated if they are to be exposed to higher than normal ambient temperatures. If the samples are to be stored before they are shipped to the laboratory, they should be kept in a freezer. The samples should be placed in a freezer upon receipt at the laboratory.

(e) Breakthrough.

(Breakthrough was defined as the relative amount of analyte found on the backup section of the tube in relation to the total amount of analyte collected on the sampling tube. Five-percent breakthrough occurred after sampling a test atmosphere containing 2.0 ppm BD for 90 min. at 0.05 L/min. At the end of this time 4.5 L of air had been sampled and 20.1 ug of the analyte was collected. The relative humidity of the sampled air was 80% at 23 deg. C.)

Breakthrough studies have shown that the recommended sampling procedure can be used at air concentrations higher than the target concentration. The sampling time, however, should be reduced to 45 min. if both the expected BD level and the relative humidity of the sampled air are high.

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(f) Desorption efficiency.

The average desorption efficiency for BD from TBC coated charcoal over the range from 0.6 to 2 times the target concentration was 96.4%. The efficiency was essentially constant over the range studied.

(g) Recommended air volume and sampling rate.

(h) The recommended air volume is 3 L.

(i) The recommended sampling rate is 0.05 L/min. for 1 hour.

(j) Interferences.

There are no known interferences to the sampling method.

(k) Safety precautions.

(i) Attach the sampling equipment to the worker in such a manner that it will not interfere with work performance or safety.

(ii) Follow all safety practices that apply to the work area being sampled.

(3) **Analytical procedure.**

(a) Apparatus.

(i) A gas chromatograph (GC), equipped with a flame ionization detector (FID).(2)

Footnote(2) *A Hewlett-Packard Model 5840A GC was used for this evaluation. Injections were performed using a Hewlett-Packard Model 7671A automatic sampler.*

(ii) A GC column capable of resolving the analytes from any interference.(3)

Footnote(3) *A 20-ft x 1/8-inch OD stainless steel GC column containing 20% FFAP on 80/100 mesh Chromabsorb W-AW-DMCS was used for this evaluation.*

(iii) Vials, glass 2-mL with Teflon-lined caps.

(iv) Disposable Pasteur-type pipets, volumetric flasks, pipets and syringes for preparing samples and standards, making dilutions and performing injections.

(b) Reagents.

(i) Carbon disulfide.(4)

Footnote(4) *Fisher Scientific Company A.C.S. Reagent Grade solvent was used in this evaluation.*

The benzene contaminant that was present in the carbon disulfide was used as an internal standard (ISTD) in this evaluation.

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(ii) Nitrogen, hydrogen and air, GC grade.

(iii) BD of known high purity.(5)

Footnote(5) *Matheson Gas Products, CP Grade 1,3-butadiene was used in this study.*

(c) Standard preparation.

(i) Prepare standards by diluting known volumes of BD gas with carbon disulfide. This can be accomplished by injecting the appropriate volume of BD into the headspace above the 1-mL of carbon disulfide contained in sealed 2-mL vial. Shake the vial after the needle is removed from the septum.(6)

Footnote(6) *A standard containing 7.71 ug/mL (at ambient temperature and pressure) was prepared by diluting 4 uL of the gas with 1-mL of carbon disulfide.*

(ii) The mass of BD gas used to prepare standards can be determined by use of the following equations:

MV = (760/BP)(273+t)/(273)(22.41)

Where:

MV = ambient molar volume BP = ambient barometric pressure T = ambient temperature ug/uL = 54.09/MV ug/standard = (ug/uL)(uL) BD used to prepare the standard.

(d) Sample preparation.

(i) Transfer the 100-mg section of the sampling tube to a 2-mL vial. Place the 50-mg section in a separate vial. If the glass wool plugs contain a significant amount of charcoal, place them with the appropriate sampling tube section.

(ii) Add 1-mL of carbon disulfide to each vial.

(iii) Seal the vials with Teflon-lined caps and then allow them to desorb for one hour. Shake the vials by hand vigorously several times during the desorption period.

(iv) If it is not possible to analyze the samples within 4 hours, separate the carbon disulfide from the charcoal, using a disposable Pasteur-type pipet, following the one hour. This separation will improve the stability of desorbed samples.

(v) Save the used sampling tubes to be cleaned and repacked with fresh adsorbent.

(e) Analysis.

(i) GC Conditions.

Column temperature: 95 deg. C

Injector temperature: 180 deg. C

Detector temperature: 275 deg. C

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Carrier gas flow rate: 30 mL/min.

Injection volume: 0.80 uL

GC column: 20-ft x 1/8-in OD stainless steel GC column containing 20%

FFAP on 80/100 Chromabsorb W-AW-DMCS.

(ii) Chromatogram. See Section 4.2.

(iii) Use a suitable method, such as electronic or peak heights, to measure detector response.

(iv) Prepare a calibration curve using several standard solutions of different concentrations.

Prepare the calibration curve daily. Program the integrator to report the results in ug/mL.

(v) Bracket sample concentrations with standards.

(f) Interferences (analytical).

(i) Any compound with the same general retention time as the analyte and which also gives a detector response is a potential interference. Possible interferences should be reported by the industrial hygienist to the laboratory with submitted samples.

(ii) GC parameters (temperature, column, etc.) may be changed to circumvent interferences.

(iii) A useful means of structure designation is GC/MS. It is recommended that this procedure be used to confirm samples whenever possible.

(g) Calculations.

(i) Results are obtained by use of calibration curves. Calibration curves are prepared by plotting detector response against concentration for each standard. The best line through the data points is determined by curve fitting.

(ii) The concentration, in ug/mL, for a particular sample is determined by comparing its detector response to the calibration curve. If any analyte is found on the backup section, this amount is added to the amount found on the front section. Blank corrections should be performed before adding the results together.

(iii) The BD air concentration can be expressed using the following equation:

$mg/m^3 = (A)(B)/(C)(D)$

Where:

A = ug/mL from Section 3.7.2 B = volume C = L of air sampled D = efficiency

(iv) The following equation can be used to convert results in mg/m^3 to ppm:

$ppm = (mg/m^3)(24.46)/54.09$

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Where:

mg/m^3 = result from Section 3.7.3. 24.46 = molar volume of an ideal gas at 760 mm Hg and 25 deg. C.

(h) Safety precautions (analytical).

(i) Avoid skin contact and inhalation of all chemicals.

(ii) Restrict the use of all chemicals to a fume hood whenever possible.

(iii) Wear safety glasses and a lab coat in all laboratory areas.

(4) **Additional Information.**

(a) A procedure to prepare specially cleaned charcoal coated with TBC.

(i) Apparatus.

(A) Magnetic stirrer and stir bar.

(B) Tube furnace capable of maintaining a temperature of 700 deg. C and equipped with a quartz tube that can hold 30 g of charcoal.(8)

Footnote(8) A Lindberg Type 55035 Tube furnace was used in this evaluation.

(C) A means to purge nitrogen gas through the charcoal inside the quartz tube.

(D) Water bath capable of maintaining a temperature of 60 deg. C.

(E) Miscellaneous laboratory equipment: One-liter vacuum flask, 1-L Erlenmeyer flask, 350-M1 Buchner funnel with a coarse fitted disc, 4-oz brown bottle, rubber stopper, Teflon tape etc.

(ii) Reagents.

(A) Phosphoric acid, 10% by weight, in water.(9)

Footnote(9) Baker Analyzed Reagent grade was diluted with water for use in this evaluation.

(B) 4-tert-Butylcatechol (TBC).(10)

Footnote(10) The Aldrich Chemical Company 99% grade was used in this evaluation.

(C) Specially cleaned coconut shell charcoal, 20/40 mesh.(11)

Footnote(11) Specially cleaned charcoal was obtained from Supelco, Inc. for use in this evaluation. The cleaning process used by Supelco is proprietary.

(D) Nitrogen gas, GC grade.

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(iii) Procedure.

Weigh 30g of charcoal into a 500-mL Erlenmeyer flask. Add about 250 mL of 10% phosphoric acid to the flask and then swirl the mixture. Stir the mixture for 1 hour using a magnetic stirrer. Filter the mixture using a fitted Buchner funnel. Wash the charcoal several times with 250-mL portions of deionized water to remove all traces of the acid.

Transfer the washed charcoal to the tube furnace quartz tube. Place the quartz tube in the furnace and then connect the nitrogen gas purge to the tube. Fire the charcoal to 700 deg. C. Maintain that temperature for at least 1 hour. After the charcoal has cooled to room temperature, transfer it to a tared beaker. Determine the weight of the charcoal and then add an amount of TBC which is 10% of the charcoal, by weight.

CAUTION-TBC is toxic and should only be handled in a fume hood while wearing gloves.

Carefully mix the contents of the beaker and then transfer the mixture to a 4-oz bottle. Stopper the bottle with a clean rubber stopper which has been wrapped with Teflon tape. Clamp the bottle in a water bath so that the water level is above the charcoal level. Gently heat the bath to 60 deg. C and then maintain that temperature for 1 hour. Cool the charcoal to room temperature and then transfer the coated charcoal to a suitable container.

The coated charcoal is now ready to be packed into sampling tubes. The sampling tubes should be stored in a sealed container to prevent contamination. Sampling tubes should be stored in the dark at room temperature. The sampling tubes should be segregated by coated adsorbent lot number.

(b) Chromatograms.

The chromatograms were obtained using the recommended analytical method. The chart speed was set at 1 cm/min. for the first three min. and then at 0.2 cm/min. for the time remaining in the analysis.

The peak which elutes just before BD is a reaction product between an impurity on the charcoal and TBC. This peak is always present, but it is easily resolved from the analyte. The peak which elutes immediately before benzene is an oxidation product of TBC.

(5) **References.**

(a) "Current Intelligence Bulletin 41, 1,3-Butadiene," U.S. Dept. of Health and Human Services, Public Health Service, Center for Disease Control, NIOSH.

(b) "NIOSH Manual of Analytical Methods," 2nd ed.; U.S. Dept. of Health Education and Welfare, National Institute for Occupational Safety and Health: Cincinnati, OH. 1977, Vol. 2, Method No. S91 DHEW (NIOSH) Publ. (U.S.), No. 77-157-B.

(c) Hawley, G.C., Ed. "The Condensed Chemical Dictionary," 8th ed.; Van Nostrand Rienhold Company: New York, 1971; 139.5.4. Chem. Eng. News (June 10, 1985), (63), 22-66.

[Statutory Authority: Chapter 49.17 RCW. 97-19-014 (Order 97-07), § 296-62-7460, filed 10/05/97, effective 11/05/97.]

Appendix E: Reserved.

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APPENDIX F, MEDICAL QUESTIONNAIRES, (Non-mandatory)

1,3-Butadiene (BD) Initial Health Questionnaire

DIRECTIONS:

You have been asked to answer the questions on this form because you work with BD (butadiene). These questions are about your work, medical history, and health concerns. Please do your best to answer all of the questions. If you need help, please tell the doctor or health care professional who reviews this form.

This form is a confidential medical record. Only information directly related to your health and safety on the job may be given to your employer. Personal health information will not be given to anyone without your consent.

Date:_____
Name:_____ SSN: ___ /__ /____
Last First MI
Job Title:_____
Company's Name:_____

Supervisor's Name: _____ Supervisor's Phone No.: (___)___-____

Work History:

1. Please list all jobs you have had in the past, starting with the job you have now and moving back in time to your first job. (For more space, write on the back of this page.)
   Main Job Duty
   Year
   Company Name
   City, State
   Chemicals
   1.
   2.
   3.
   4.
   5.
   6.
   7.
   8.
2. Please describe what you do during a typical work day. Be sure to tell about your work with BD.
3. Please check any of these chemicals that you work with now or have worked with in the past:

benzene	_____
glues	_____
toluene	_____
inks, dyes	_____
other solvents, grease cutters	_____
insecticides (like DDT, lindane, etc.)	_____
paints, varnishes, thinners, strippers	_____
dusts	_____
carbon tetrachloride (“carbon tet”)	_____
arsine	_____
carbon disulfide	_____
lead	_____
cement	_____
petroleum products	_____
nitrites	_____

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4. Please check the protective clothing or equipment you use at the job you have now:
   gloves _____
   coverall _____
   respirator _____
   dust mask _____
   safety glasses, goggles _____

Please circle your answer.

5. Does your protective clothing or equipment fit you properly? yes no
6. Have you ever made changes in your protective clothing or equipment to make it fit better? yes no
7. Have you been exposed to BD when you were not wearing protective clothing or equipment? yes no
8. Where do you eat, drink and/or smoke when you are at work? (Please check all that apply.)
   Cafeteria/restaurant/snack bar _____
   Break room/employee lounge _____
   Smoking lounge _____
   At my work station _____

Please circle your answer.

9. Have you been exposed to radiation (like x-rays or nuclear material) at the job you have now or at past jobs? yes no
10. Do you have any hobbies that expose you to dusts or chemicals (including paints, glues, etc.)? yes no
11. Do you have any second or side jobs? yes no
    If yes, what are your duties there?
12. Were you in the military? yes no
    If yes, what did you do in the military?

Family Health History

1. In the FAMILY MEMBER column, across from the disease name, write which family member, if any, had the disease.

DISEASE	FAMILY MEMBER
Cancer	
Lymphoma	
Sickle Cell Disease or Trait	
Immune Disease	
Leukemia	
Anemia	

2. Please fill in the following information about family health

Relative	Alive?	Age at Death?	Cause of Death?
Father			
Mother			
Brother/Sister			
Brother/Sister			
Brother/Sister			

Personal Health History

Birth Date__/__/__ Age___ Sex__ Height_____ Weight_____

Please circle your answer.

1. Do you smoke any tobacco products? yes no

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2. Have you ever had any kind of surgery or operation? yes no
If yes, what type of surgery:_____
_____

3. Have you ever been in the hospital for any other reasons? yes no
If yes, please describe the reason:_____
_____

4. Do you have any on-going or current medical problems or conditions? yes no
If yes, please describe:_____
_____

5. Do you now have or have you ever had any of the following? Please check all that apply to you.

unexplained fever	_____
anemia (“low blood”)	_____
HIV/AIDS	_____
weakness	_____
sickle cell	_____
miscarriage	_____
skin rash	_____
bloody stools	_____
leukemia/lymphoma	_____
neck mass/swelling	_____
wheezing	_____
yellowing of skin	_____
bruising easily	_____
lupus	_____
weight loss	_____
kidney problems	_____
enlarged lymph nodes	_____
liver disease	_____
cancer	_____
infertility	_____
drinking problems	_____
thyroid problems	_____
night sweats	_____
chest pain	_____
still birth	_____
eye redness	_____
lumps you can feel	_____
child with birth defect	_____
autoimmune disease	_____
overly tired	_____
lung problems	_____
rheumatoid arthritis	_____
mononucleosis (“mono”)	_____
nagging cough	_____

Please circle your answer.

6. Do you have any symptoms or health problems that you think may be related to your work with BD?
yes no
If yes, please describe:_____
_____

7. Have any of your co-workers had similar symptoms or problems?
yes no don't know
If yes, please describe:_____
_____

8. Do you notice any irritation of your eyes, nose, throat, lungs, or skin when working with BD?
yes no

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9. Do you notice any blurred vision, coughing, drowsiness, nausea, or headache when working with BD? yes no
10. Do you take any medications (including birth control or over-the-counter)? yes no
    If yes, please list:_____
    _____
11. Are you allergic to any medication, food, or chemicals? yes no
    If yes, please list:_____
    _____
12. Do you have any health conditions not covered by this questionnaire that you think are affected by your work with BD? yes no
    If yes, please explain:_____
    _____
13. Did you understand all the questions? yes no

Signature _____

1,3-Butadiene (BD) Health Update Questionnaire

DIRECTIONS:
You have been asked to answer the questions on this form because you work with BD (butadiene). These questions are about your work, medical history, and health concerns. Please do your best to answer all of the questions. If you need help, please tell the doctor or health care professional who reviews this form.
This form is a confidential medical record. Only information directly related to your health and safety on the job may be given to your employer. Personal health information will not be given to anyone without your consent.

Date:_____
Name:_____ SSN:___/__/____
Last First MI
Job Title:_____
Company's Name:_____
Supervisor's Name:_____ Supervisor's Phone No.:(___)___-____

1. Please describe any NEW duties that you have at your job:_____
_____
_____
2. Please describe any additional job duties you have:
   _____ _____
   _____ _____
   _____ _____
   _____ _____

Please circle your answer.

3. Are you exposed to any other chemicals in your work since the last time you were evaluated for exposure to BD? yes no
   If yes, please list what they are:_____
   _____
4. Does your personal protective equipment and clothing fit you properly? yes no
5. Have you made changes in this equipment or clothing to make if fit better? yes no
6. Have you been exposed to BD when you were not wearing protective clothing or equipment? yes no
7. Are you exposed to any NEW chemicals at home or while working on hobbies? yes no
   If yes, please list what they are:
8. Since your last BD health evaluation, have you started working any new second or side jobs? yes no
   If yes, what are your duties there?_____
   _____

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Personal Health History

1. What is your current weight?_____pounds
2. Have you been diagnosed with any new medical conditions or illness since your last evaluation? yes no
   If yes, please tell what they are:_____
   _____
3. Since your last evaluation, have you been in the hospital for any illnesses, injuries, or surgery? yes no
   If yes, please describe:_____
   _____
4. Do you have any of the following? Please place a check for all that apply to you.

unexplained fever	_____
anemia (“low blood”)	_____
HIV/AIDS	_____
weakness	_____
sickle cell	_____
miscarriage	_____
skin rash	_____
bloody stools	_____
leukemia/lymphoma	_____
neck mass/swelling	_____
wheezing	_____
yellowing of skin	_____
bruising easily	_____
lupus	_____
weight loss	_____
kidney problems	_____
enlarged lymph nodes	_____
liver disease	_____
cancer	_____
infertility	_____
drinking problems	_____
thyroid problems	_____
night sweats	_____
chest pain	_____
still birth	_____
eye redness	_____
lumps you can feel	_____
child with birth defect	_____
autoimmune disease	_____
overly tired	_____
lung problems	_____
rheumatoid arthritis	_____
mononucleosis (“mono”)	_____
nagging cough	_____

Please circle your answer.

5. Do you have any symptoms or health problems that you think may be related to your work with BD? yes no
   If yes, please describe:_____
   _____
6. Have any of your co-workers had similar symptoms or problems?
   yes no don't know
   If yes, please describe:_____
   _____

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7. Do you notice any irritation of your eyes, nose, throat, lungs, or skin when working with BD?
   yes no
8. Do you notice any blurred vision, coughing, drowsiness, nausea, or headache when working with BD?yes
   no
9. Have you been taking any NEW medications (including birth control or over-the-counter)?
   yes no
   If yes, please list: _____ _____ _____
   _____ _____ _____
10. Have you developed any new allergies to medications, foods, or chemicals? yes no
    If yes, please list: _____ _____ _____
    _____ _____ _____
11. Do you have any health conditions not covered by this questionnaire that you think are affected by your work with BD? yes no
    If yes, please explain:_____
    _____
12. Do you understand all the questions? yes no
    *Signature _____

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07460, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07460, filed 05/04/99, effective 09/01/99. Statutory Authority: Statutory Authority: Chapter 49.17 RCW. 97-19-014 (Order 97-07), § 296-62-07460, filed 10/05/97, effective 11/05/97.]

WAC 296-62-07470 Methylene chloride.

This occupational health standard establishes requirements for employers to control occupational exposure to methylene chloride (MC). Employees exposed to MC are at increased risk of developing cancer, adverse effects on the heart, central nervous system and liver, and skin or eye irritation. Exposure may occur through inhalation, by absorption through the skin, or through contact with the skin. MC is a solvent which is used in many different types of work activities, such as paint stripping, polyurethane foam manufacturing, and cleaning and degreasing. Under the requirements of subsection (4) of this section, each covered employer must make an initial determination of each employee's exposure to MC. If the employer determines that employees are exposed below the action level, the only other provisions of this section that apply are that a record must be made of the determination, the employees must receive information and training under subsection (12) of this section and, where appropriate, employees must be protected from contact with liquid MC under subsection (8) of this section.

The provisions of the MC standard are as follows:

(1) Scope and application. This section applies to all occupational exposures to methylene chloride (MC), Chemical Abstracts Service Registry Number 75-09-2, in general industry, construction and shipyard employment.

(2) **Definitions.** For the purposes of this section, the following definitions shall apply:

"Action level" means a concentration of airborne MC of 12.5 parts per million (ppm) calculated as an eight (8)-hour time-weighted average (TWA).

"Authorized person" means any person specifically authorized by the employer and required by work duties to be present in regulated areas, or any person entering such an area as a designated representative of employees for the purpose of exercising the right to observe monitoring and measuring procedures under subsection (4) of this section, or any other person authorized by the WISH Act or regulations issued under the act.

"Director" means the director of the department of labor and industries, or designee.

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"Emergency" means any occurrence, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which results, or is likely to result in an uncontrolled release of MC. If an incidental release of MC can be controlled by employees such as maintenance personnel at the time of release and in accordance with the leak/spill provisions required by subsection (6) of this section, it is not considered an emergency as defined by this standard.

"Employee exposure" means exposure to airborne MC which occurs or would occur if the employee were not using respiratory protection.

"Methylene chloride (MC)" means an organic compound with chemical formula, CH_2C1_2. Its Chemical Abstracts Service Registry Number is 75-09-2. Its molecular weight is 84.9 g/mole.

"Physician or other licensed health care professional" is an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by subsection (10) of this section.

"Regulated area" means an area, demarcated by the employer, where an employee's exposure to airborne concentrations of MC exceeds or can reasonably be expected to exceed either the 8-hour TWA PEL or the STEL.

"Symptom" means central nervous system effects such as headaches, disorientation, dizziness, fatigue, and decreased attention span; skin effects such as chapping, erythema, cracked skin, or skin burns; and cardiac effects such as chest pain or shortness of breath.

"This section" means this methylene chloride standard.

(3) **Permissible exposure limits (PELs).**

(a) Eight-hour time-weighted average (TWA) PEL. The employer shall ensure that no employee is exposed to an airborne concentration of MC in excess of twenty-five parts of MC per million parts of air (25 ppm) as an 8-hour TWA.

(b) Short-term exposure limit (STEL). The employer shall ensure that no employee is exposed to an airborne concentration of MC in excess of one hundred and twenty-five parts of MC per million parts of air (125 ppm) as determined over a sampling period of fifteen minutes.

(4) **Exposure monitoring.**

(a) Characterization of employee exposure.

(i) Where MC is present in the workplace, the employer shall determine each employee's exposure by either:

(A) Taking a personal breathing zone air sample of each employee's exposure; or

(B) Taking personal breathing zone air samples that are representative of each employee's exposure.

(ii) Representative samples. The employer may consider personal breathing zone air samples to be representative of employee exposures when they are taken as follows:

(A) 8-hour TWA PEL. The employer has taken one or more personal breathing zone air samples for at least one employee in each job classification in a work area during every work shift, and the employee sampled is expected to have the highest MC exposure.

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(B) Short-term exposure limits. The employer has taken one or more personal breathing zone air samples which indicate the highest likely 15-minute exposures during such operations for at least one employee in each job classification in the work area during every work shift, and the employee sampled is expected to have the highest MC exposure.

(C) Exception. Personal breathing zone air samples taken during one work shift may be used to represent employee exposures on other work shifts where the employer can document that the tasks performed and conditions in the workplace are similar across shifts.

(iii) Accuracy of monitoring. The employer shall ensure that the methods used to perform exposure monitoring produce results that are accurate to a confidence level of 95 percent, and are:

(A) Within plus or minus 25 percent for airborne concentrations of MC above the 8-hour TWA PEL or the STEL; or

(B) Within plus or minus 35 percent for airborne concentrations of MC at or above the action level but at or below the 8-hour TWA PEL.

(b) Initial determination. Each employer whose employees are exposed to MC shall perform initial exposure monitoring to determine each affected employee's exposure, except under the following conditions:

(i) Where objective data demonstrate that MC cannot be released in the workplace in airborne concentrations at or above the action level or above the STEL. The objective data shall represent the highest MC exposures likely to occur under reasonably foreseeable conditions of processing, use, or handling. The employer shall document the objective data exemption as specified in subsection (13) of this section;

(ii) Where the employer has performed exposure monitoring within 12 months prior to December 1, and that exposure monitoring meets all other requirements of this section, and was conducted under conditions substantially equivalent to existing conditions; or

(iii) Where employees are exposed to MC on fewer than 30 days per year (e.g., on a construction site), and the employer has measurements by direct reading instruments which give immediate results (such as a detector tube) and which provide sufficient information regarding employee exposures to determine what control measures are necessary to reduce exposures to acceptable levels.

(c) Periodic monitoring. Where the initial determination shows employee exposures at or above the action level or above the STEL, the employer shall establish an exposure monitoring program for periodic monitoring of employee exposure to MC in accordance with Table 1:

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Table 1
Six Initial Determination Exposure Scenarios
and Their Associated Monitoring Frequencies

Exposure scenario	Required monitoring activity
Below the action level and at or below the STEL.	No 8-hour TWA or STEL monitoring required.
Below the action level and above the STEL.	No 8-hour TWA monitoring required, monitor STEL exposures every three months.
At or above the action level, at or below the TWA, and at or below the STEL.	Monitor 8-hour TWA exposures every six months.
At or above the action level, at or below the TWA, and above the STEL.	Monitor 8-hour TWA exposures every six months and monitor STEL exposures every three months.
Above the TWA and at or below the STEL	Monitor 8-hour TWA exposures every three months. In addition, without regard to the last sentence of the note to subsection (3) of this section, the following employers must monitor STEL exposures every three months until either the date by which they must achieve the 8-hour TWAs PEL under subsection (3) of this section or the date by which they in fact achieve the 8-hour TWA PEL, whichever comes first. • Employers engaged in polyurethane foam manufacturing; • Foam fabrication; • Furniture refinishing; • General aviation aircraft stripping; • Product formulation; • Use of MC-based adhesives for boat building and repair; • Recreational vehicle manufacture, van conversion, or upholstery, and use of MC in construction work for restoration and preservation of buildings, painting and paint removal, cabinet making, or floor refinishing and resurfacing.
Above the TWA and above the STEL	Monitor both 8-hour TWA exposures and STEL exposures every three months.

(Note to subsection (3)(c) of this section: The employer may decrease the frequency of exposure monitoring to every six months when at least 2 consecutive measurements taken at least 7 days apart show exposures to be at or below the 8-hour TWA PEL. The employer may discontinue the periodic 8-hour TWA monitoring for employees where at least two consecutive measurements taken at least 7 days apart are below the action level. The employer may discontinue the periodic STEL monitoring for employees where at least two consecutive measurements taken at least 7 days apart are at or below the STEL.)

(d) Additional monitoring.

(i) The employer shall perform exposure monitoring when a change in workplace conditions indicates that employee exposure may have increased. Examples of situations that may require additional monitoring include changes in production, process, control equipment, or work-practices, or a leak, rupture, or other breakdown.

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(ii) Where exposure monitoring is performed due to a spill, leak, rupture or equipment breakdown, the employer shall clean up the MC and perform the appropriate repairs before monitoring.

(e) Employee notification of monitoring results.

(i) The employer shall, within 15 working days after the receipt of the results of any monitoring performed under this section, notify each affected employee of these results in writing, either individually or by posting of results in an appropriate location that is accessible to affected employees.

(ii) Whenever monitoring results indicate that employee exposure is above the 8-hour TWA PEL or the STEL, the employer shall describe in the written notification the corrective action being taken to reduce employee exposure to or below the 8-hour TWA PEL or STEL and the schedule for completion of this action.

(f) Observation of monitoring.

(i) Employee observation. The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to MC conducted in accordance with this section.

(ii) Observation procedures. When observation of the monitoring of employee exposure to MC requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide, at no cost to the observer(s), and the observer(s) shall be required to use such clothing and equipment and shall comply with all other applicable safety and health procedures.

(5) **Regulated areas.**

(a) The employer shall establish a regulated area wherever an employee's exposure to airborne concentrations of MC exceeds or can reasonably be expected to exceed either the 8-hour TWA PEL or the STEL.

(b) The employer shall limit access to regulated areas to authorized persons.

(c) The employer shall supply a respirator, selected in accordance with subsection (7)(c) of this section, to each person who enters a regulated area and shall require each affected employee to use that respirator whenever MC exposures are likely to exceed the 8-hour TWA PEL or STEL.

(Note to subsection (5)(c) of this section: An employer who has implemented all feasible engineering, work-practice and administrative controls (as required in subsection (6) of this section), and who has established a regulated area (as required by subsection (5)(a) of this section) where MC exposure can be reliably predicted to exceed the 8-hour TWA PEL or the STEL only on certain days (for example, because of work or process schedule) would need to have affected employees use respirators in that regulated area only on those days.)

(d) The employer shall ensure that, within a regulated area, employees do not engage in nonwork activities which may increase dermal or oral MC exposure.

(e) The employer shall ensure that while employees are wearing respirators, they do not engage in activities (such as taking medication or chewing gum or tobacco) which interfere with respirator seal or performance.

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(f) The employer shall demarcate regulated areas from the rest of the workplace in any manner that adequately establishes and alerts employees to the boundaries of the area and minimizes the number of authorized employees exposed to MC within the regulated area.

(g) An employer at a multi-employer worksite who establishes a regulated area shall communicate the access restrictions and locations of these areas to all other employers with work operations at that worksite.

(6) **Methods of compliance.**

(a) Engineering and work-practice controls. The employer shall institute and maintain the effectiveness of engineering controls and work-practices to reduce employee exposure to or below the PELs except to the extent that the employer can demonstrate that such controls are not feasible.

(b) Wherever the feasible engineering controls and work-practices which can be instituted are not sufficient to reduce employee exposure to or below the 8-TWA PEL or STEL, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection that complies with the requirements of subsection (7) of this section.

(c) Prohibition of rotation. The employer shall not implement a schedule of employee rotation as a means of compliance with the PELs.

(d) Leak and spill detection.

(i) The employer shall implement procedures to detect leaks of MC in the workplace. In work areas where spills may occur, the employer shall make provisions to contain any spills and to safely dispose of any MC-contaminated waste materials.

(ii) The employer shall ensure that all incidental leaks are repaired and that incidental spills are cleaned promptly by employees who use the appropriate personal protective equipment and are trained in proper methods of cleanup.

(Note to subsection (6)(d)(ii) of this section: See Appendix A of this section for examples of procedures that satisfy this requirement. Employers covered by this standard may also be subject to the hazardous waste and emergency response provisions contained in WAC 296-62-3112.)

(7) **Respiratory protection.**

(a) General requirements. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods when an employee's exposure to MC exceeds or can reasonably be expected to exceed the 8-hour TWA PEL or the STEL for example, when an employee is using MC in a regulated area);

(ii) Periods necessary to install or implement feasible engineering and work-practice controls;

(iii) In a few work operations, such as some maintenance operations and repair activities, for which the employer demonstrates that engineering and work-practice controls are infeasible;

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(iv) Work operations for which feasible engineering and work-practice controls are not sufficient to reduce exposures to or below the PELs;

(v) Emergencies.

(b) Respirator program.

(i) The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07131(4)(b)(i) and (ii)).

(ii) Employers who provide employees with gas masks with organic-vapor canisters for the purpose of emergency escape must replace the canisters after any emergency use and before the gas masks are returned to service.

(c) Respirator selection. The employer must select appropriate atmosphere-supplying respirators from Table 2 of this section.

Table 2.--Minimum Requirements for Respiratory Protection for Airborne Methylene Chloride

Methylene chloride airborne concentration (ppm) or condition of use	Minimum respirator required[1]
Up to 625 ppm (25 x PEL)	(1) Continuous flow supplied-air respirator, hood or helmet.
Up to 1250 ppm (50 x 8-hr TWA PEL)	(1) Full facepiece, supplied-air respirator operated in negative-pressure (demand) mode. (2) Full facepiece self-contained breathing apparatus (SCBA) operated in negative-pressure (demand) mode.
Up to 5000 ppm (200 x 8-TWA PEL)	(1) Continuous flow supplied-air respirator, full facepiece. (2) Pressure-demand supplied-air respirator, full facepiece. (3) Positive-pressure full facepiece SCBA.
Unknown concentration, or above 5000 ppm (Greater than 200 x 8-TWA PEL)	(1) Positive-pressure full facepiece SCBA (2) Full facepiece pressure-demand supplied-air respirator with an auxiliary self-contained air supply.
Firefighting	(1) Positive pressure full facepiece SCBA.
Emergency escape	(1) Any continuous flow or pressure-demand SCBA. (2) Gas mask with organic vapor canister.

[1] Respirators assigned for higher airborne concentrations may be used at lower concentrations.

(d) Medical evaluation. Before having an employee use a supplied-air respirator in the negative-pressure mode, or a gas mask with an organic-vapor canister for emergency escape, the employer must:

(i) Have a physician or other licensed health care professional (PLHCP) evaluate the employee's ability to use such respiratory protection;

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(ii) Ensure that the PLHCP provides their findings in a written opinion to the employee and the employer.

Note: See WAC 296-62-07150 through 296-62-07156 for medical evaluation requirements for employees using respirators.

(8) **Protective work clothing and equipment.**

(a) Where needed to prevent MC- induced skin or eye irritation, the employer shall provide clean protective clothing and equipment which is resistant to MC, at no cost to the employee, and shall ensure that each affected employee uses it. Eye and face protection shall meet the requirements of WAC 296-800-160, as applicable.

(b) The employer shall clean, launder, repair and replace all protective clothing and equipment required by this subsection as needed to maintain their effectiveness.

(c) The employer shall be responsible for the safe disposal of such clothing and equipment.

(Note to subsection (8)(c) of this section: See Appendix A for examples of disposal procedures that will satisfy this requirement.)

(9) **Hygiene facilities.**

(a) If it is reasonably foreseeable that employees' skin may contact solutions containing 0.1 percent or greater MC (for example, through splashes, spills or improper work-practices), the employer shall provide conveniently located washing facilities capable of removing the MC, and shall ensure that affected employees use these facilities as needed.

(b) If it is reasonably foreseeable that an employee's eyes may contact solutions containing 0.1 percent or greater MC (for example through splashes, spills or improper work-practices), the employer shall provide appropriate eyewash facilities within the immediate work area for emergency use, and shall ensure that affected employees use those facilities when necessary.

(10) **Medical surveillance.**

(a) Affected employees. The employer shall make medical surveillance available for employees who are or may be exposed to MC as follows:

(i) At or above the action level on 30 or more days per year, or above the 8-hour TWA PEL or the STEL on 10 or more days per year;

(ii) Above the 8-TWA PEL or STEL for any time period where an employee has been identified by a physician or other licensed health care professional as being at risk from cardiac disease or from some other serious MC-related health condition and such employee requests inclusion in the medical surveillance program;

(iii) During an emergency.

(b) Costs. The employer shall provide all required medical surveillance at no cost to affected employees, without loss of pay and at a reasonable time and place.

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(c) Medical personnel. The employer shall ensure that all medical surveillance procedures are performed by a physician or other licensed health care professional, as defined in subsection (2) of this section.

(d) Frequency of medical surveillance. The employer shall make medical surveillance available to each affected employee as follows:

(i) Initial surveillance. The employer shall provide initial medical surveillance under the schedule provided by subsection (14)(b)(iii) of this section, or before the time of initial assignment of the employee, whichever is later. The employer need not provide the initial surveillance if medical records show that an affected employee has been provided with medical surveillance that complies with this section within 12 months before December 1.

(ii) Periodic medical surveillance. The employer shall update the medical and work history for each affected employee annually. The employer shall provide periodic physical examinations, including appropriate laboratory surveillance, as follows:

(A) For employees 45 years of age or older, within 12 months of the initial surveillance or any subsequent medical surveillance; and

(B) For employees younger than 45 years of age, within 36 months of the initial surveillance or any subsequent medical surveillance.

(iii) Termination of employment or reassignment. When an employee leaves the employer's workplace, or is reassigned to an area where exposure to MC is consistently at or below the action level and STEL, medical surveillance shall be made available if six months or more have elapsed since the last medical surveillance.

(iv) Additional surveillance. The employer shall provide additional medical surveillance at frequencies other than those listed above when recommended in the written medical opinion. (For example, the physician or other licensed health care professional may determine an examination is warranted in less than 36 months for employees younger than 45 years of age based upon evaluation of the results of the annual medical and work history.)

(e) Content of medical surveillance.

(i) Medical and work history. The comprehensive medical and work history shall emphasize neurological symptoms, skin conditions, history of hematologic or liver disease, signs or symptoms suggestive of heart disease (angina, coronary artery disease), risk factors for cardiac disease, MC exposures, and work-practices and personal protective equipment used during such exposures.

(Note to subsection (10)(e)(i) of this section: See Appendix B of this section for an example of a medical and work history format that would satisfy this requirement.)

(ii) Physical examination. Where physical examinations are provided as required above, the physician or other licensed health care professional shall accord particular attention to the lungs, cardiovascular system (including blood pressure and pulse), liver, nervous system, and skin. The physician or other licensed health care professional shall determine the extent and nature of the physical examination based on the health status of the employee and analysis of the medical and work history.

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(ii) Laboratory surveillance. The physician or other licensed health care professional shall determine the extent of any required laboratory surveillance based on the employee's observed health status and the medical and work history.

(Note to subsection (10)(e)(iii) of this section: See Appendix B of this section for information regarding medical tests. Laboratory surveillance may include before-and after-shift carboxyhemoglobin determinations, resting ECG, hematocrit, liver function tests and cholesterol levels.)

(iv) Other information or reports. The medical surveillance shall also include any other information or reports the physician or other licensed health care professional determines are necessary to assess the employee's health in relation to MC exposure.

(f) Content of emergency medical surveillance. The employer shall ensure that medical surveillance made available when an employee has been exposed to MC in emergency situations includes, at a minimum:

(i) Appropriate emergency treatment and decontamination of the exposed employee;

(ii) Comprehensive physical examination with special emphasis on the nervous system, cardiovascular system, lungs, liver and skin, including blood pressure and pulse;

(iii) Updated medical and work history, as appropriate for the medical condition of the employee; and

(iv) Laboratory surveillance, as indicated by the employee's health status.

(Note to subsection (10)(f)(iv) of this section: See Appendix B for examples of tests which may be appropriate.)

(g) Additional examinations and referrals. Where the physician or other licensed health care professional determines it is necessary, the scope of the medical examination shall be expanded and the appropriate additional medical surveillance, such as referrals for consultation or examination, shall be provided.

(h) Information provided to the physician or other licensed health care professional. The employer shall provide the following information to a physician or other licensed health care professional who is involved in the diagnosis of MC-induced health effects:

(i) A copy of this section including its applicable appendices;

(ii) A description of the affected employee's past, current and anticipated future duties as they relate to the employee's MC exposure;

(iii) The employee's former or current exposure levels or, for employees not yet occupationally exposed to MC, the employee's anticipated exposure levels and the frequency and exposure levels anticipated to be associated with emergencies;

(iv) A description of any personal protective equipment, such as respirators, used or to be used; and

(v) Information from previous employment-related medical surveillance of the affected employee which is not otherwise available to the physician or other licensed health care professional.

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(i) Written medical opinions.

(i) For each physical examination required by this section, the employer shall ensure that the physician or other licensed health care professional provides to the employer and to the affected employee a written opinion regarding the results of that examination within 15 days of completion of the evaluation of medical and laboratory findings, but not more than 30 days after the examination. The written medical opinion shall be limited to the following information:

(A) The physician's or other licensed health care professional's opinion concerning whether exposure to MC may contribute to or aggravate the employee's existing cardiac, hepatic, neurological (including stroke) or dermal disease or whether the employee has any other medical conditions(s) that would place the employee's health at increased risk of material impairment from exposure to MC;

(B) Any recommended limitations upon the employee's exposure to MC, removal from MC exposure, or upon the employee's use of protective clothing or equipment and respirators;

(C) A statement that the employee has been informed by the physician or other licensed health care professional that MC is a potential occupational carcinogen, of risk factors for heart disease, and the potential for exacerbation of underlying heart disease by exposure to MC through its metabolism to carbon monoxide; and

(D) A statement that the employee has been informed by the physician or other licensed health care professional of the results of the medical examination and any medical conditions resulting from MC exposure which require further explanation or treatment.

(ii) The employer shall instruct the physician or other licensed health care professional not to reveal to the employer, orally or in the written opinion, any specific records, findings, and diagnoses that have no bearing on occupational exposure to MC.

(Note to subsection (10)(h)(ii) of this section: The written medical opinion may also include information and opinions generated to comply with other OSHA health standards.)

(j) Medical presumption. For purposes of this subsection (10), the physician or other licensed health care professional shall presume, unless medical evidence indicates to the contrary, that a medical condition is unlikely to require medical removal from MC exposure if the employee is not exposed to MC above the 8-hour TWA PEL. If the physician or other licensed health care professional recommends removal for an employee exposed below the 8-hour TWA PEL, the physician or other licensed health care professional shall cite specific medical evidence, sufficient to rebut the presumption that exposure below the 8-hour TWA PEL is unlikely to require removal, to support the recommendation. If such evidence is cited by the physician or other licensed health care professional, the employer must remove the employee. If such evidence is not cited by the physician or other licensed health care professional, the employer is not required to remove the employee.

(k) Medical removal protection (MRP).

(i) Temporary medical removal and return of an employee.

WAC 296-62-07470 (Cont.)

(A) Except as provided in (j) of this subsection, when a medical determination recommends removal because the employee's exposure to MC may contribute to or aggravate the employee's existing cardiac, hepatic, neurological (including stroke), or skin disease, the employer must provide medical removal protection benefits to the employee and either:

(I) Transfer the employee to comparable work where methylene chloride exposure is below the action level; or

(II) Remove the employee from MC exposure.

(B) If comparable work is not available and the employer is able to demonstrate that removal and the costs of extending MRP benefits to an additional employee, considering feasibility in relation to the size of the employer's business and the other requirements of this standard, make further reliance on MRP an inappropriate remedy, the employer may retain the additional employee in the existing job until transfer or removal becomes appropriate, provided:

(I) The employer ensures that the employee receives additional medical surveillance, including a physical examination at least every 60 days until transfer or removal occurs; and

(II) The employer or PLHCP informs the employee of the risk to the employee's health from continued MC exposure.

(C) The employer shall maintain in effect any job-related protective measures or limitations, other than removal, for as long as a medical determination recommends them to be necessary.

(ii) End of MRP benefits and return of the employee to former job status.

(A) The employer may cease providing MRP benefits at the earliest of the following:

(I) Six months;

(II) Return of the employee to the employee's former job status following receipt of a medical determination concluding that the employee's exposure to MC no longer will aggravate any cardiac, hepatic, neurological (including stroke), or dermal disease;

(III) Receipt of a medical determination concluding that the employee can never return to MC exposure.

(B) For the purposes of this subsection (10), the requirement that an employer return an employee to the employee's former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(l) Medical removal protection benefits.

WAC 296-62-07470 (Cont.)

(i) For purposes of this subsection (10), the term medical removal protection benefits means that, for each removal, an employer must maintain for up to six months the earnings, seniority, and other employment rights and benefits of the employee as though the employee had not been removed from MC exposure or transferred to a comparable job.

(ii) During the period of time that an employee is removed from exposure to MC, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(iii) If a removed employee files a workers' compensation claim for a MC-related disability, the employer shall continue the MRP benefits required by this section until either the claim is resolved or the 6-month period for payment of MRP benefits has passed, whichever occurs first. To the extent the employee is entitled to indemnity payments for earnings lost during the period of removal, the employer's obligation to provide medical removal protection benefits to the employee shall be reduced by the amount of such indemnity payments.

(iv) The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal from either a publicly or an employer-funded compensation program, or receives income from employment with another employer made possible by virtue of the employee's removal.

(m) Voluntary removal or restriction of an employee. Where an employer, although not required by this section to do so, removes an employee from exposure to MC or otherwise places any limitation on an employee due to the effects of MC exposure on the employee's medical condition, the employer shall provide medical removal protection benefits to the employee equal to those required by (l) of this subsection.

(n) Multiple health care professional review mechanism.

(i) If the employer selects the initial physician or licensed health care professional (PLHCP) to conduct any medical examination or consultation provided to an employee under (k) of this subsection, the employer shall notify the employee of the right to seek a second medical opinion each time the employer provides the employee with a copy of the written opinion of that PLHCP.

(ii) If the employee does not agree with the opinion of the employer-selected PLHCP, notifies the employer of that fact, and takes steps to make an appointment with a second PLHCP within 15 days of receiving a copy of the written opinion of the initial PLHCP, the employer shall pay for the PLHCP chosen by the employee to perform at least the following:

(A) Review any findings, determinations or recommendations of the initial PLHCP; and

(B) Conduct such examinations, consultations, and laboratory tests as the PLHCP deems necessary to facilitate this review.

(iii) If the findings, determinations or recommendations of the second PLHCP differ from those of the initial PLHCP, then the employer and the employee shall instruct the two health care professionals to resolve the disagreement.

WAC 296-62-07470 (Cont.)

(iv) If the two health care professionals are unable to resolve their disagreement within 15 days, then those two health care professionals shall jointly designate a PLHCP who is a specialist in the field at issue. The employer shall pay for the specialist to perform at least the following:

(A) Review the findings, determinations, and recommendations of the first two PLHCPs; and

(B) Conduct such examinations, consultations, laboratory tests and discussions with the prior PLHCPs as the specialist deems necessary to resolve the disagreements of the prior health care professionals.

(v) The written opinion of the specialist shall be the definitive medical determination. The employer shall act consistent with the definitive medical determination, unless the employer and employee agree that the written opinion of one of the other two PLHCPs shall be the definitive medical determination.

(vi) The employer and the employee or authorized employee representative may agree upon the use of any expeditious alternate health care professional determination mechanism in lieu of the multiple health care professional review mechanism provided by this section so long as the alternate mechanism otherwise satisfies the requirements contained in this section.

(11) **Hazard communication.** The employer shall communicate the following hazards associated with MC on labels and in material safety data sheets in accordance with the requirements of the chemical hazard communication standard, WAC 296-800-170: cancer, cardiac effects (including elevation of carboxyhemoglobin), central nervous system effects, liver effects, and skin and eye irritation.

(12) **Employee information and training.**

(a) The employer shall provide information and training for each affected employee prior to or at the time of initial assignment to a job involving potential exposure to MC.

(b) The employer shall ensure that information and training is presented in a manner that is understandable to the employees.

(c) In addition to the information required under the chemical hazard communication standard at WAC 296-800-170:

(i) The employer shall inform each affected employee of the requirements of this section and information available in its appendices, as well as how to access or obtain a copy of it in the workplace;

(ii) Wherever an employee's exposure to airborne concentrations of MC exceeds or can reasonably be expected to exceed the action level, the employer shall inform each affected employee of the quantity, location, manner of use, release, and storage of MC and the specific operations in the workplace that could result in exposure to MC, particularly noting where exposures may be above the 8-hour TWA PEL or STEL;

(d) The employer shall train each affected employee as required under the chemical hazard communication standard at WAC 296-800-170, as appropriate.

WAC 296-62-07470 (Cont.)

(e) The employer shall re-train each affected employee as necessary to ensure that each employee exposed above the action level or the STEL maintains the requisite understanding of the principles of safe use and handling of MC in the workplace.

(f) Whenever there are workplace changes, such as modifications of tasks or procedures or the institution of new tasks or procedures, which increase employee exposure, and where those exposures exceed or can reasonably be expected to exceed the action level, the employer shall update the training as necessary to ensure that each affected employee has the requisite proficiency.

(g) An employer whose employees are exposed to MC at a multi-employer worksite shall notify the other employers with work operations at that site in accordance with the requirements of the chemical hazard communication standard, WAC 296-800-170, as appropriate.

(h) The employer shall provide to the director, upon request, all available materials relating to employee information and training.

(13) **Recordkeeping.**

(a) Objective data.

(i) Where an employer seeks to demonstrate that initial monitoring is unnecessary through reasonable reliance on objective data showing that any materials in the workplace containing MC will not release MC at levels which exceed the action level or the STEL under foreseeable conditions of exposure, the employer shall establish and maintain an accurate record of the objective data relied upon in support of the exemption.

(ii) This record shall include at least the following information:

(A) The MC-containing material in question;

(B) The source of the objective data;

(C) The testing protocol, results of testing, and/or analysis of the material for the release of MC;

(D) A description of the operation exempted under subsection (4)(b)(i) of this section and how the data support the exemption; and

(E) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(iii) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(b) Exposure measurements.

(i) The employer shall establish and keep an accurate record of all measurements taken to monitor employee exposure to MC as prescribed in subsection (4) of this section.

(ii) Where the employer has 20 or more employees, this record shall include at least the following information:

WAC 296-62-07470 (Cont.)

(A) The date of measurement for each sample taken;

(B) The operation involving exposure to MC which is being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy;

(D) Number, duration, and results of samples taken;

(E) Type of personal protective equipment, such as respiratory protective devices, worn, if any; and

(F) Name, Social Security number, job classification and exposure of all of the employees represented by monitoring, indicating which employees were actually monitored.

(iii) Where the employer has fewer than 20 employees, the record shall include at least the following information:

(A) The date of measurement for each sample taken;

(B) Number, duration, and results of samples taken; and

(C) Name, Social Security number, job classification and exposure of all of the employees represented by monitoring, indicating which employees were actually monitored.

(iv) The employer shall maintain this record for at least thirty (30) years, in accordance with WAC 296-62-052.

(c) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance under subsection (10) of this section.

(ii) The record shall include at least the following information:

(A) The name, Social Security number and description of the duties of the employee;

(B) Written medical opinions; and

(C) Any employee medical conditions related to exposure to MC.

(iii) The employer shall ensure that this record is maintained for the duration of employment plus thirty (30) years, in accordance with WAC 296-62-052.

(d) Availability. The employer, upon written request, shall make all records required to be maintained by this section available to the director for examination and copying in accordance with WAC 296-62-052.

WAC 296-62-07470 (Cont.)

(Note to subsection (13)(d)(i) of this section: All records required to be maintained by this section may be kept in the most administratively convenient form (for example, electronic or computer records would satisfy this requirement).)

(ii) The employer, upon request, shall make any employee exposure and objective data records required by this section available for examination and copying by affected employees, former employees, and designated representatives in accordance with WAC 296-62-052.

(iii) The employer, upon request, shall make employee medical records required to be kept by this section available for examination and copying by the subject employee and by anyone having the specific written consent of the subject employee in accordance with WAC 296-62-052.

(e) Transfer of records. The employer shall comply with the requirements concerning transfer of records set forth in WAC 296-62-05215.

(14) **Dates.**

(a) Engineering controls required under subsection (6)(a) of this section shall be implemented according to the following schedule:

(i) For employers with fewer than 20 employees, no later than April 10, 2000.

(ii) For employers with fewer than 150 employees engaged in foam fabrication; for employers with fewer that 50 employees engaged in furniture refinishing, general aviation aircraft stripping, and product formulation; for employers with fewer than 50 employees using MC-based adhesives for boat building and repair, recreational vehicle manufacture, van conversion, and upholstering; for employers with fewer than 50 employees using MC in construction work for restoration and preservation of buildings, painting and paint removal, cabinet making and/or floor refinishing and resurfacing, no later than April 10, 2000.

(iii) For employers engaged in polyurethane foam manufacturing with 20 or more employees, no later than October 10, 1999.

(b) Use of respiratory protection whenever an employee's exposure to MC exceeds or can reasonably be expected to exceed the 8-hour TWA PEL, in accordance with subsection (3)(a), (5)(c), (6)(a) and (7)(a) of this section, shall be implemented according to the following schedule:

(i) For employers with fewer than 150 employees engaged in foam fabrication; for employers with fewer than 50 employees engaged in furniture refinishing, general aviation aircraft stripping, and product formulation; for employers with fewer than 50 employees using MC-based adhesives for boat building and repair, recreational vehicle manufacture, van conversion, and upholstering; for employers with fewer than 50 employees using MC in construction work for restoration and preservation of buildings, painting and paint removal, cabinet making and/or floor refinishing and resurfacing, no later than April 10, 2000.

(ii) For employers engaged in polyurethane foam manufacturing with 20 or more employees, no later than October 10, 1999.

(c) Notification of corrective action under subsection (4)(e)(ii) of this section, no later than 90 days before the compliance date applicable to such corrective action.

WAC 296-62-07470 (Cont.)

(d) Transitional dates. The exposure limits for MC specified in WAC 296-62-07515 Table 1, shall remain in effect until the start-up dates for the exposure limits specified in subsection (14) of this section, or if the exposure limits in this section are stayed or vacated.

(e) Unless otherwise specified in this subsection(14), all other requirements of this section shall be complied with immediately.

(15) **Appendices.** The information contained in the appendices does not, by itself, create any additional obligations not otherwise imposed or detract from any existing obligation.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07470, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07470, filed 05/04/99, effective 09/01/99.] Statutory Authority: Statutory Authority: RCW 49.17.040, .050, .060, 97-18-062 (Order 97-08), § 296-62-07470, filed 9/2/97, effective 12/1/97.]

WAC 296-62-07473 Appendix A. Substance Safety Data Sheet and Technical Guidelines for Methylene Chloride

I. **Substance Identification**

A. Substance: Methylene chloride (CH_2Cl_2).

B. Synonyms: MC, Dichloromethane (DCM); Methylene dichloride; Methylene bichloride; Methane dichloride; CAS: 75-09-2; NCI-C50102.

C. Physical data:

1. Molecular weight: 84.9.

2. Boiling point (760 mm Hg): 39.8 deg.C (104 deg.F).

3. Specific gravity (water = 1): 1.3.

4. Vapor density (air = 1 at boiling point): 2.9.

5. Vapor pressure at 20 deg. C (68 deg. F): 350 mm Hg.

6. Solubility in water, g/100 g water at 20 deg. C (68 deg. F) = 1.32.

7. Appearance and odor: colorless liquid with a chloroform-like odor.

D. Uses: MC is used as a solvent, especially where high volatility is required. It is a good solvent for oils, fats, waxes, resins, bitumen, rubber and cellulose acetate and is a useful paint stripper and degreaser. It is used in paint removers, in propellant mixtures for aerosol containers, as a solvent for plastics, as a degreasing agent, as an extracting agent in the pharmaceutical industry and as a blowing agent in polyurethane foams. Its solvent property is sometimes increased by mixing with methanol, petroleum naphtha or tetrachloroethylene.

E. Appearance and odor: MC is a clear colorless liquid with a chloroform-like odor. It is slightly soluble in water and completely miscible with most organic solvents.

F. Permissible exposure: Exposure may not exceed 25 parts MC per million parts of air (25 ppm) as an eight-hour time-weighted average (8-hour TWA PEL) or 125 parts of MC per million parts of air (125 ppm) averaged over a 15-minute period (STEL).

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II. **Health Hazard Data**

A. MC can affect the body if it is inhaled or if the liquid comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

B. Effects of overexposure:

1. Short-term Exposure: MC is an anesthetic. Inhaling the vapor may cause mental confusion, light- headedness, nausea, vomiting, and headache. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and even death. High vapor concentrations may also cause irritation of the eyes and respiratory tract. Exposure to MC may make the symptoms of angina (chest pains) worse. Skin exposure to liquid MC may cause irritation. If liquid MC remains on the skin, it may cause skin burns. Splashes of the liquid into the eyes may cause irritation.

2. Long-term (chronic) exposure: The best evidence that MC causes cancer is from laboratory studies in which rats, mice and hamsters inhaled MC 6 hours per day, 5 days per week for 2 years. MC exposure produced lung and liver tumors in mice and mammary tumors in rats. No carcinogenic effects of MC were found in hamsters. There are also some human epidemiological studies which show an association between occupational exposure to MC and increases in biliary (bile duct) cancer and a type of brain cancer. Other epidemiological studies have not observed a relationship between MC exposure and cancer. WISHA interprets these results to mean that there is suggestive (but not absolute) evidence that MC is a human carcinogen.

C. Reporting signs and symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to MC.

D. Warning Properties:

1. Odor Threshold: Different authors have reported varying odor thresholds for MC. Kirk-Othmer and Sax both reported 25 to 50 ppm; Summer and May both reported 150 ppm; Spector reports 320 ppm. Patty, however, states that since one can become adapted to the odor, MC should not be considered to have adequate warning properties.

2. Eye Irritation Level: Kirk-Othmer reports that “MC vapor is seriously damaging to the eyes.” Sax agrees with Kirk-Othmer's statement. The ACGIH Documentation of TLVs states that irritation of the eyes has been observed in workers exposed to concentrations up to 5000 ppm.

3. Evaluation of Warning Properties: Since a wide range of MC odor thresholds are reported (25-320 ppm), and human adaptation to the odor occurs, MC is considered to be a material with poor warning properties.

III. **Emergency First Aid Procedures**

In the event of emergency, institute first aid procedures and send for first aid or medical assistance.

A. Eye and Skin Exposures: If there is a potential for liquid MC to come in contact with eye or skin, face shields and skin protective equipment must be provided and used. If liquid MC comes in contact with the eye, get medical attention. Contact lenses should not be worn when working with this chemical.

WAC 296-62-07473 (Cont.)

B. Breathing: If a person breathes in large amounts of MC, move the exposed person to fresh air at once. If breathing has stopped, perform cardiopulmonary resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.

C. Rescue: Move the affected person from the hazardous exposure immediately. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises. Do not become a casualty yourself.

IV. **Respirators, Protective Clothing, and Eye Protection**

A. Respirators: Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work-practice controls are not feasible, when such controls are in the process of being installed, or when these controls fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the National Institute for Occupational Safety and Health (NIOSH). Supplied-air respirators are required because air-purifying respirators do not provide adequate respiratory protection against MC. In addition to respirator selection, a complete written respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation. If you can smell MC while wearing a respirator, proceed immediately to fresh air. If you experience difficulty in breathing while wearing a respirator, tell your employer.

B. Protective Clothing: Employees must be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid MC or contact with vessels containing liquid MC. Any clothing which becomes wet with liquid MC should be removed immediately and not reworn until the employer has ensured that the protective clothing is fit for reuse. Contaminated protective clothing should be placed in a regulated area designated by the employer for removal of MC before the clothing is laundered or disposed of. Clothing and equipment should remain in the regulated area until all of the MC contamination has evaporated; clothing and equipment should then be laundered or disposed of as appropriate.

C. Eye Protection: Employees should be provided with and required to use splash-proof safety goggles where liquid MC may contact the eyes.

V. **Housekeeping and Hygiene Facilities**

For purposes of complying with WAC 296-24-120, 296-800-220 and 296-800-230, the following items should be emphasized:

A. The workplace should be kept clean, orderly, and in a sanitary condition. The employer should institute a leak and spill detection program for operations involving liquid MC in order to detect sources of fugitive MC emissions.

B. Emergency drench showers and eyewash facilities are recommended. These should be maintained in a sanitary condition. Suitable cleansing agents should also be provided to assure the effective removal of MC from the skin.

WAC 296-62-07473 (Cont.)

C. Because of the hazardous nature of MC, contaminated protective clothing should be placed in a regulated area designated by the employer for removal of MC before the clothing is laundered or disposed of.

VI. **Precautions for Safe Use, Handling, and Storage**

A. Fire and Explosion Hazards: MC has no flash point in a conventional closed tester, but it forms flammable vapor-air mixtures at approximately 100 deg.C (212 deg.F), or higher. It has a lower explosion limit of 12%, and an upper explosion limit of 19% in air. It has an autoignition temperature of 556.1 deg.C (1033 deg.F), and a boiling point of 39.8 deg.C (104 deg.F). It is heavier than water with a specific gravity of 1.3. It is slightly soluble in water.

B. Reactivity Hazards: Conditions contributing to the instability of MC are heat and moisture. Contact with strong oxidizers, caustics, and chemically active metals such as aluminum or magnesium powder, sodium and potassium may cause fires and explosions. Special precautions: Liquid MC will attack some forms of plastics, rubber, and coatings.

C. Toxicity: Liquid MC is painful and irritating if splashed in the eyes or if confined on the skin by gloves, clothing, or shoes. Vapors in high concentrations may cause narcosis and death. Prolonged exposure to vapors may cause cancer or exacerbate cardiac disease.

D. Storage: Protect against physical damage. Because of its corrosive properties, and its high vapor pressure, MC should be stored in plain, galvanized or lead lined, mild steel containers in a cool, dry, well ventilated area away from direct sunlight, heat source and acute fire hazards.

E. Piping Material: All piping and valves at the loading or unloading station should be of material that is resistant to MC and should be carefully inspected prior to connection to the transport vehicle and periodically during the operation.

F. Usual Shipping Containers: Glass bottles, 5- and 55-gallon steel drums, tank cars, and tank trucks.

Note: This section addresses MC exposure in marine terminal and longshore employment only where leaking or broken packages allow MC exposure that is not addressed through compliance with WAC 296-56.

G. Electrical Equipment: Electrical installations in Class I hazardous locations as defined in Article 500 of the National Electrical Code, should be installed according to Article 501 of the code; and electrical equipment should be suitable for use in atmospheres containing MC vapors. See Flammable and Combustible Liquids Code (NFPA No. 325M), Chemical Safety Data Sheet SD-86 (Manufacturing Chemists' Association, Inc.).

H. Fire Fighting: When involved in fire, MC emits highly toxic and irritating fumes such as phosgene, hydrogen chloride and carbon monoxide. Wear breathing apparatus and use water spray to keep fire-exposed containers cool. Water spray may be used to flush spills away from exposures. Extinguishing media are dry chemical, carbon dioxide, foam. For purposes of compliance with WAC 296-24-956, locations classified as hazardous due to the presence of MC shall be Class I.

I. Spills and Leaks: Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed. If MC has spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

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2. Ventilate area of spill or leak.

3. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

J. Methods of Waste Disposal: Small spills should be absorbed onto sand and taken to a safe area for atmospheric evaporation. Incineration is the preferred method for disposal of large quantities by mixing with a combustible solvent and spraying into an incinerator equipped with acid scrubbers to remove hydrogen chloride gases formed. Complete combustion will convert carbon monoxide to carbon dioxide. Care should be taken for the presence of phosgene.

K. You should not keep food, beverage, or smoking materials, or eat or smoke in regulated areas where MC concentrations are above the permissible exposure limits.

L. Portable heating units should not be used in confined areas where MC is used.

M. Ask your supervisor where MC is used in your work area and for any additional plant safety and health rules.

VII. **Medical Requirements**

Your employer is required to offer you the opportunity to participate in a medical surveillance program if you are exposed to MC at concentrations at or above the action level (12.5 ppm 8-hour TWA) for more than 30 days a year or at concentrations exceeding the PELs (25 ppm 8-hour TWA or 125 ppm 15-minute STEL) for more than 10 days a year. If you are exposed to MC at concentrations over either of the PELs, your employer will also be required to have a physician or other licensed health care professional ensure that you are able to wear the respirator that you are assigned. Your employer must provide all medical examinations relating to your MC exposure at a reasonable time and place and at no cost to you.

VIII. **Monitoring and Measurement Procedures**

A. Exposure above the Permissible Exposure Limit:

1. Eight-hour exposure evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken with consecutive samples covering the full shift. Air samples must be taken in the employee's breathing zone.

2. Monitoring techniques: The sampling and analysis under this section may be performed by collection of the MC vapor on two charcoal adsorption tubes in series or other composition adsorption tubes, with subsequent chemical analysis. Sampling and analysis may also be performed by instruments such as real-time continuous monitoring systems, portable direct reading instruments, or passive dosimeters as long as measurements taken using these methods accurately evaluate the concentration of MC in employees' breathing zones. OSHA method 80 is an example of a validated method of sampling and analysis of MC. Copies of this method are available from OSHA or can be downloaded from the Internet at http://www.osha.gov. The employer has the obligation of selecting a monitoring method which meets the accuracy and precision requirements of the standard under his or her unique field conditions. The standard requires that the method of monitoring must be accurate, to a 95 percent confidence level, to plus or minus 25 percent for concentrations of MC at or above 25 ppm, and to plus or minus 35 percent for concentrations at or below 25 ppm. In addition to OSHA method 80, there are numerous other methods available for monitoring for MC in the workplace.

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B. Since many of the duties relating to employee exposure are dependent on the results of measurement procedures, employers must assure that the evaluation of employee exposure is performed by a technically qualified person.

IX. **Observation of Monitoring**

Your employer is required to perform measurements that are representative of your exposure to MC and you or your designated representative are entitled to observe the monitoring procedure. You are entitled to observe the steps taken in the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you or your representative must also be provided with, and must wear, protective clothing and equipment.

Access To Information

A. Your employer is required to inform you of the information contained in this Appendix. In addition, your employer must instruct you in the proper work-practices for using MC, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to MC. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure. If your employer determines that you are being over exposed, he or she is required to inform you of the actions which are being taken to reduce your exposure to within permissible exposure limits.

C. Your employer is required to keep records of your exposures and medical examinations. These records must be kept by the employer for at least thirty (30) years.

D. Your employer is required to release your exposure and medical records to you or your representative upon your request.

E. Your employer is required to provide labels and material safety data sheets (MSDS) for all materials, mixtures or solutions composed of greater than 0.1 percent MC. An example of a label that would satisfy these requirements would be:

Danger Contains Methylene Chloride
Potential Cancer Hazard
May worsen heart disease because methylene chloride is converted to carbon monoxide in the body.
May cause dizziness, headache, irritation of the throat and lungs, loss of consciousness and death at high concentrations (for example, if used in a poorly ventilated room).
Avoid Skin Contact. Contact with liquid causes skin and eye irritation.

X. **Common Operations and Controls**

The following list includes some common operations in which exposure to MC may occur and control methods which may be effective in each case:

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Operations	Controls
Use as solvent in paint and varnish removers cold cleaning and ultrasonic cleaning, and as a solvent in furniture stripping.	General dilution ventilation; local; manufacture of aerosols; cold cleaning exhaust ventilation; personal protective equipment; substitution.
Use as solvent in vapor degreasing.	Process enclosure; local exhaust ventilation, chilling coils; substitution
Use as a secondary refrigerant in air. Scientific testing.	General dilution ventilation; local conditioning and exhaust ventilation; personal protective equipment.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038 (Order 99-36), § 296-62-07473, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040, .050, .060,97-18-062 (Order 97-08), § 296-62-07473, filed 9/2/97, effective 12/1/97.]

WAC 296-62-07475 Appendix B. Medical Surveillance for Methylene Chloride

I. **Primary Route of Entry Inhalation.**

II. **Toxicology.**

Methylene Chloride (MC) is primarily an inhalation hazard. The principal acute hazardous effects are the depressant action on the central nervous system, possible cardiac toxicity and possible liver toxicity. The range of CNS effects are from decreased eye/hand coordination and decreased performance in vigilance tasks to narcosis and even death of individuals exposed at very high doses. Cardiac toxicity is due to the metabolism of MC to carbon monoxide, and the effects of carbon monoxide on heart tissue. Carbon monoxide displaces oxygen in the blood, decreases the oxygen available to heart tissue, increasing the risk of damage to the heart, which may result in heart attacks in susceptible individuals. Susceptible individuals include persons with heart disease and those with risk factors for heart disease. Elevated liver enzymes and irritation to the respiratory passages and eyes have also been reported for both humans and experimental animals exposed to MC vapors.

MC is metabolized to carbon monoxide and carbon dioxide via two separate pathways. Through the first pathway, MC is metabolized to carbon monoxide as an end-product via the P-450 mixed function oxidase pathway located in the microsomal fraction of the cell. This biotransformation of MC to carbon monoxide occurs through the process of microsomal oxidative dechlorination which takes place primarily in the liver. The amount of conversion to carbon monoxide is significant as measured by the concentration of carboxyhemoglobin, up to 12% measured in the blood following occupational exposure of up to 610 ppm.

Through the second pathway, MC is metabolized to carbon dioxide as an end product (with formaldehyde and formic acid as metabolic intermediates) via the glutathione dependent enzyme found in the cytosolic fraction of the liver cell. Metabolites along this pathway are believed to be associated with the carcinogenic activity of MC.

MC has been tested for carcinogenicity in several laboratory rodents. These rodent studies indicate that there is clear evidence that MC is carcinogenic to male and female mice and female rats. Based on epidemiologic studies, OSHA has concluded that there is suggestive evidence of increased cancer risk in MC-related worker populations. The epidemiological evidence is consistent with the finding of excess cancer in the experimental animal studies. NIOSH regards MC as a potential occupational carcinogen and the International Agency for Research Cancer (IARC) classifies MC as an animal carcinogen. OSHA considers MC as a suspected human carcinogen.

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III. **Medical Signs and Symptoms of Acute Exposure**

Skin exposure to liquid MC may cause irritation or skin burns. Liquid MC can also be irritating to the eyes. MC is also absorbed through the skin and may contribute to the MC exposure by inhalation. At high concentrations in air, MC may cause nausea, vomiting, light- headedness, numbness of the extremities, changes in blood enzyme levels, and breathing problems, leading to bronchitis and pulmonary edema, unconsciousness and even death.

At lower concentrations in air, MC may cause irritation to the skin, eye, and respiratory tract and occasionally headache and nausea. Perhaps the greatest problem from exposure to low concentrations of MC is the CNS effects on coordination and alertness that may cause unsafe operations of machinery and equipment, leading to self-injury or accidents. Low levels and short duration exposures do not seem to produce permanent disability, but chronic exposures to MC have been demonstrated to produce liver toxicity in animals, and therefore, the evidence is suggestive for liver toxicity in humans after chronic exposure. Chronic exposure to MC may also cause cancer.

IV. **Surveillance and Preventive Considerations**

As discussed above, MC is classified as a suspect or potential human carcinogen. It is a central nervous system (CNS) depressant and a skin, eye and respiratory tract irritant. At extremely high concentrations, MC has caused liver damage in animals. MC principally affects the CNS, where it acts as a narcotic. The observation of the symptoms characteristic of CNS depression, along with a physical examination, provides the best detection of early neurological disorders. Since exposure to MC also increases the carboxyhemoglobin level in the blood, ambient carbon monoxide levels would have an additive effect on that carboxyhemoglobin level. Based on such information, a periodic post- shift carboxyhemoglobin test as an index of the presence of carbon monoxide in the blood is recommended, but not required, for medical surveillance.

Based on the animal evidence and three epidemiologic studies previously mentioned, OSHA concludes that MC is a suspect human carcinogen. The medical surveillance program is designed to observe exposed workers on a regular basis. While the medical surveillance program cannot detect MC-induced cancer at a preneoplastic stage, OSHA anticipates that, as in the past, early detection and treatments of cancers leading to enhanced survival rates will continue to evolve.

A. Medical and Occupational History:

The medical and occupational work history plays an important role in the initial evaluation of workers exposed to MC. It is therefore extremely important for the examining physician or other licensed health care professional to evaluate the MC-exposed worker carefully and completely and to focus the examination on MC's potentially associated health hazards. The medical evaluation must include an annual detailed work and medical history with special emphasis on cardiac history and neurological symptoms.

An important goal of the medical history is to elicit information from the worker regarding potential signs or symptoms associated with increased levels of carboxyhemoglobin due to the presence of carbon monoxide in the blood. Physicians or other licensed health care professionals should ensure that the smoking history of all MC exposed employees is known. Exposure to MC may cause a significant increase in carboxyhemoglobin level in all exposed persons. However, smokers as well as workers with anemia or heart disease and those concurrently exposed to carbon monoxide are at especially high risk of toxic effects because of an already reduced oxygen carrying capacity of the blood.

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A comprehensive or interim medical and work history should also include occurrence of headache, dizziness, fatigue, chest pain, shortness of breath, pain in the limbs, and irritation of the skin and eyes. In addition, it is important for the physician or other licensed health care professional to become familiar with the operating conditions in which exposure to MC is likely to occur. The physician or other licensed health care professional also must become familiar with the signs and symptoms that may indicate that a worker is receiving otherwise unrecognized and exceptionally high exposure levels of MC.

An example of a medical and work history that would satisfy the requirement for a comprehensive or interim work history is represented by the following:

The following is a list of recommended questions and issues for the self- administered questionnaire for methylene chloride exposure.

Questionnaire For Methylene Chloride Exposure

I. **Demographic Information**

1. Name_____
2. Social Security Number_____
3. Date _____
4. Date of Birth_____
5. Age _____
6. Present occupation_____
7. Sex _____
8. Race _____

II. **Occupational History**

1. Have you ever worked with methylene chloride, dichloromethane, methylene dichloride, or CH_2Cl_2 (all are different names for the same chemical)? Please list which on the occupational history form if you have not already.
2. If you have worked in any of the following industries and have not listed them on the occupational history form, please do so.
   Furniture stripping_____
   Polyurethane foam manufacturing_____
   Chemical manufacturing or formulation_____
   Pharmaceutical manufacturing_____
   Any industry in which you used solvents to clean and degrease equipment or parts_____
   Construction, especially painting and refinishing_____
   Aerosol manufacturing_____
   Any industry in which you used aerosol adhesives_____
3. If you have not listed hobbies or household projects on the occupational history form, especially furniture refinishing, spray painting, or paint stripping, please do so.

III. **Medical History**

A. **General**

1. Do you consider yourself to be in good health? If no, state reason(s).

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2. Do you or have you ever had:
   a. Persistent thirst
   b. Frequent urination (three times or more at night)
   c. Dermatitis or irritated skin
   d. Nonhealing wounds
3. What prescription or nonprescription medications do you take, and for what reasons?
4. Are you allergic to any medications, and what type of reaction do you have?

B. **Respiratory**

1. Do you have or have you ever had any chest illnesses or diseases? Explain.
2. Do you have or have you ever had any of the following:
   a. Asthma
   b. Wheezing
   c. Shortness of breath
3. Have you ever had an abnormal chest X-ray? If so, when, where, and what were the findings?
4. Have you ever had difficulty using a respirator or breathing apparatus? Explain.
5. Do any chest or lung diseases run in your family? Explain.
6. Have you ever smoked cigarettes, cigars, or a pipe? Age started:
7. Do you now smoke?
8. If you have stopped smoking completely, how old were you when you stopped?
9. On the average of the entire time you smoked, how many packs of cigarettes, cigars, or bowls of tobacco did you smoke per day?

C. **Cardiovascular**

1. Have you ever been diagnosed with any of the following:
   Which of the following apply to you now or did apply to you at some time in the past, even if the problem is controlled by medication? Please explain any yes answers (i.e., when problem was diagnosed, length of time on medication).
   a. High cholesterol or triglyceride level
   b. Hypertension (high blood pressure)
   c. Diabetes
   d. Family history of heart attack, stroke, or blocked arteries
2. Have you ever had chest pain? If so, answer the next five questions.
   a. What was the quality of the pain (i.e., crushing, stabbing, squeezing)?
   b. Did the pain go anywhere (i.e., into jaw, left arm)?
   c. What brought the pain out?
   d. How long did it last?
   e. What made the pain go away?
3. Have you ever had heart disease, a heart attack, stroke, aneurysm, or blocked arteries anywhere in your body? Explain (when, treatment).
4. Have you ever had bypass surgery for blocked arteries in your heart or anywhere else? Explain.
5. Have you ever had any other procedures done to open up a blocked artery (balloon angioplasty, carotid endarterectomy, clot-dissolving drug)?
6. Do you have or have you ever had (explain each):
   a. Heart murmur
   b. Irregular heartbeat
   c. Shortness of breath while lying flat
   d. Congestive heart failure

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e. Ankle swelling
f. Recurrent pain anywhere below the waist while walking

7. Have you ever had an electrocardiogram (EKG)? When?
8. Have you ever had an abnormal EKG? If so, when, where, and what were the findings?
9. Do any heart diseases, high blood pressure, diabetes, high cholesterol, or high triglycerides run in your family? Explain.

D. **Hepatobiliary and Pancreas**

1. Do you now or have you ever drunk alcoholic beverages? Age started: _____ Age stopped: _____.
2. Average numbers per week:
   a. Beers:_____, ounces in usual container:
   b. Glasses of wine:_____, ounces per glass:
   c. Drinks:_____, ounces in usual container:
3. Do you have or have you ever had (explain each):
   a. Hepatitis (infectious, autoimmune, drug-induced, or chemical)
   b. Jaundice
   c. Elevated liver enzymes or elevated bilirubin
   d. Liver disease or cancer

E. **Central Nervous System**

1. Do you or have you ever had (explain each):
   a. Headache
   b. Dizziness
   c. Fainting
   d. Loss of consciousness
   e. Garbled speech
   f. Lack of balance
   g. Mental/psychiatric illness
   h. Forgetfulness

F. **Hematologic**

1. Do you have, or have you ever had (explain each):
   a. Anemia
   b. Sickle cell disease or trait
   c. Glucose-6-phosphate dehydrogenase deficiency
   d. Bleeding tendency disorder

2. If not already mentioned previously, have you ever had a reaction to sulfa drugs or to drugs used to prevent or treat malaria? What was the drug? Describe the reaction.

B. Physical Examination

The complete physical examination, when coupled with the medical and occupational history, assists the physician or other licensed health care professional in detecting pre-existing conditions that might place the employee at increased risk, and establishes a baseline for future health monitoring. These examinations should include:

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1. Clinical impressions of the nervous system, cardiovascular function and pulmonary function, with additional tests conducted where indicated or determined by the examining physician or other licensed health care professional to be necessary.

2. An evaluation of the advisability of the worker using a respirator, because the use of certain respirators places an additional burden on the cardiopulmonary system. It is necessary for the attending physician or other licensed health care professional to evaluate the cardiopulmonary function of these workers, in order to inform the employer in a written medical opinion of the worker's ability or fitness to work in an area requiring the use of certain types of respiratory protective equipment. The presence of facial hair or scars that might interfere with the worker's ability to wear certain types of respirators should also be noted during the examination and in the written medical opinion.

   Because of the importance of lung function to workers required to wear certain types of respirators to protect themselves from MC exposure, these workers must receive an assessment of pulmonary function before they begin to wear a negative pressure respirator and at least annually thereafter.

   The recommended pulmonary function tests include measurement of the employee's forced vital capacity (FVC), forced expiratory volume at one second (FEV_1), as well as calculation of the ratios of FEV_1 to FVC, and the ratios of measured FVC and measured FEV_1 to expected respective values corrected for variation due to age, sex, race, and height. Pulmonary function evaluation must be conducted by a physician or other licensed health care professional experienced in pulmonary function tests.

   The following is a summary of the elements of a physical exam which would fulfill the requirements under the MC standard:

Physical Exam

I. Skin and appendages

   1. Irritated or broken skin
   2. Jaundice
   3. Clubbing cyanosis, edema
   4. Capillary refill time
   5. Pallor

II. Head
   1. Facial deformities
   2. Scars
   3. Hair growth

III. Eyes

   1. Scleral icterus
   2. Corneal arcus
   3. Pupillary size and response
   4. Fundoscopic exam

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IV. Chest

1. Standard exam

V. Heart

1. Standard exam
2 Jugular vein distension
3. Peripheral pulses

VI. Abdomen

1. Liver span

VII. Nervous System

1. Complete standard neurologic exam

VIII. Laboratory

1. Hemoglobin and hematocrit
2. Alanine aminotransferase (ALT, SGPT)
3. Post-shift carboxyhemoglobin

I. Studies

1. Pulmonary function testing
2. Electrocardiogram

An evaluation of the oxygen carrying capacity of the blood of employees (for example by measured red blood cell volume) is considered useful, especially for workers acutely exposed to MC. It is also recommended, but not required, that end of shift carboxyhemoglobin levels be determined periodically, and any level above 3% for nonsmokers and above 10% for smokers should prompt an investigation of the worker and his workplace. This test is recommended because MC is metabolized to CO, which combines strongly with hemoglobin, resulting in a reduced capacity of the blood to transport oxygen in the body. This is of particular concern for cigarette smokers because they already have a diminished hemoglobin capacity due to the presence of CO in cigarette smoke.

C. Additional Examinations and Referrals

1. Examination by a Specialist

When a worker examination reveals unexplained symptoms or signs (i.e. in the physical examination or in the laboratory tests), follow-up medical examinations are necessary to assure that MC exposure is not adversely affecting the worker's health. When the examining physician or other licensed health care professional finds it necessary, additional tests should be included to determine the nature of the medical problem and the underlying cause. Where relevant, the worker should be sent to a specialist for further testing and treatment as deemed necessary. The final rule requires additional investigations to be covered and it also permits physicians or other licensed health care professionals to add appropriate or necessary tests to improve the diagnosis of disease should such tests become available in the future.

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2. Emergencies

The examination of workers exposed to MC in an emergency should be directed at the organ systems most likely to be affected. If the worker has received a severe acute exposure, hospitalization may be required to assure proper medical intervention. It is not possible to precisely define "severe," but the physician or other licensed health care professional's judgment should not merely rest on hospitalization. If the worker has suffered significant conjunctival, oral, or nasal irritation, respiratory distress, or discomfort, the physician or other licensed health care professional should instigate appropriate follow-up procedures. These include attention to the eyes, lungs and the neurological system. The frequency of follow-up examinations should be determined by the attending physician or other licensed health care professional. This testing permits the early identification essential to proper medical management of such workers.

D. Employer Obligations

The employer is required to provide the responsible physician or other licensed health care professional and any specialists involved in a diagnosis with the following information: a copy of the MC standard including relevant appendices, a description of the affected employee's duties as they relate to his or her exposure to MC; an estimate of the employee's exposure including duration (e.g., 15hr/wk, three 8-hour shifts/wk, full time); a description of any personal protective equipment used by the employee, including respirators; and the results of any previous medical determinations for the affected employee related to MC exposure to the extent that this information is within the employer's control.

E. Physicians' or Other Licensed Health Care Professionals' Obligations

The standard requires the employer to ensure that the physician or other licensed health care professional provides a written statement to the employee and the employer. This statement should contain the physician's or licensed health care professional's opinion as to whether the employee has any medical condition placing him or her at increased risk of impaired health from exposure to MC or use of respirators, as appropriate. The physician or other licensed health care professional should also state his or her opinion regarding any restrictions that should be placed on the employee's exposure to MC or upon the use of protective clothing or equipment such as respirators. If the employee wears a respirator as a result of his or her exposure to MC, the physician or other licensed health care professional's opinion should also contain a statement regarding the suitability of the employee to wear the type of respirator assigned.
Furthermore, the employee should be informed by the physician or other licensed health care professional about the cancer risk of MC and about risk factors for heart disease, and the potential for exacerbation of underlying heart disease by exposure to MC through its metabolism to carbon monoxide. Finally, the physician or other licensed health care professional should inform the employer that the employee has been told the results of the medical examination and of any medical conditions which require further explanation or treatment. This written opinion must not contain any information on specific findings or diagnosis unrelated to employee's occupational exposures.

The purpose in requiring the examining physician or other licensed health care professional to supply the employer with a written opinion is to provide the employer with a medical basis to assist the employer in placing employees initially, in assuring that their health is not being impaired by exposure to MC, and to assess the employee's ability to use any required protective equipment.

[Statutory Authority: RCW 49.17.040, .050, .060, 97-08-062 (Order 97-08), § 296-62-07475, filed 9/2/97, effective 12/1/97.]

WAC 296-62-07477 Appendix C. Questions and answers--methylene chloride in furniture stripping.

(Adapted from NIOSH Pubication No. 93-133)

Introduction

This appendix answers commonly asked questions about the hazards from exposure to methylene chloride. It also describes approaches to controlling methylene chloride exposure during the most common furniture stripping processes. Although these approaches were developed and field tested by the National Institute of Occupational Safety and Health, each setting requires custom installation because of the different air flow interferences at each site.

1. What is the Stripping Solution Base?

The most common active ingredient in paint removers is a chemical called methylene chloride. Methylene chloride is present in the paint remover to penetrate, blister, and finally lift the old finish. Other chemicals in paint removers work to accelerate the stripping process, to retard evaporation, and to act as thickening agents. These other ingredients may include: methanol, toluene, acetone, or paraffin.1

2. Is Methylene Chloride Bad for Me?

Exposure to methylene chloride may cause short-term health effects or long-term health effects.

Short-Term (Acute) Health Effects

Exposure to high levels of paint removers over short periods of time can cause irritation to the skin, eyes, mucous membranes, and respiratory tracts. Other symptoms of high exposure are dizziness, headache, and lack of coordination. The occurrence of any of these symptoms indicates that you are being exposed to high levels of methylene chloride. At the onset of any of these symptoms, you should leave the work area, get
some fresh air, and determine why the levels were high.

A portion of inhaled methylene chloride is converted by the body to carbon monoxide, which can lower the blood's ability to carry oxygen. When the solvent is used properly, however, the levels of carbon monoxide should not be hazardous. Individuals with cardiovascular or pulmonary health problems should check with their physician before using the paint stripper. Individuals experiencing severe symptoms such as shortness of breath or chest pains should obtain proper medical care immediately.[1]

Long-Term (Chronic) Health Effects

Methylene chloride has been shown to cause cancer in certain laboratory animal tests. The available human studies do not provide the necessary information to determine whether methylene chloride causes cancer in humans. However, as a result of the animal studies, methylene chloride is considered a potential occupational carcinogen. There is also considerable indirect evidence to suggest that workers exposed to methylene chloride may be at an increased risk of developing ischemic heart disease. Therefore, it is prudent to minimize exposure to solvent vapors.[3]

3. What does the Methylene Chloride Standard Require?

On January 10, 1997, the Occupational Safety and Health Administration published a new regulation for methylene chloride. The standard establishes an eight-hour time-weighted average exposure limit of 25 parts per million (ppm), as well as a short-term exposure limit of 125 ppm determined from a 15 minute sampling period. That is a reduction from the current WISHA limit of 100 ppm. The standard also sets a 12.5 ppm action level (a level that would trigger periodic exposure monitoring and medical surveillance provisions).[2] WISHA adopted an identical standard on [date].

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The National Institute for Occupational Safety and Health recommends that methylene chloride be regarded as a "potential occupational carcinogen." NIOSH further recommends that occupational exposure to methylene chloride be controlled to the lowest feasible limit. This recommendation was based on the observation of cancers and tumors in both rats and mice exposed to methylene chloride in air.[5]

4. How Can I Be Exposed to Methylene Chloride while Stripping Furniture?

Methylene chloride can be inhaled when vapors are in the air. Inhalation of the methylene chloride vapors is generally the most important source of exposure. Methylene chloride evaporates quicker than most chemicals. The odor threshold of methylene chloride is 300 ppm.[6] Therefore, once you smell methylene chloride, you are being over-exposed. Pouring, moving, or stirring the chemical will increase the rate of evaporation.

Methylene chloride can be absorbed through the skin either by directly touching the chemical or through your gloves. Methylene chloride can be swallowed if it gets on your hands, clothes, or beard, or if food or drinks become contaminated.

5. How Can Breathing Exposures be Reduced?

Install a Local Exhaust Ventilation System

Local exhaust ventilation can be used to control exposures. Local exhaust ventilation systems capture contaminated air from the source before it spreads into the workers' breathing zone.[7] If engineering controls are not effective, only a self-contained breathing apparatus equipped with a full face piece and operated in a positive-pressure mode or a supplied-air respirator affords the level of protection. Air-purifying respirators such as gas masks with organic vapor canisters can only be used for escape situations.[8] These gas masks are not suitable for normal work situations because methylene chloride is poorly absorbed by the canister filtering material.

A local exhaust system consists of the following: a hood, a fan, ductwork, and a replacement air system.[9,10,11] Two processes are commonly used in furniture stripping: flow-over and dip tanks. For flow-over systems there are two common local exhaust controls for methylene chloride - a slot hood and a down draft hood. A slot hood of different design is most often used for dip tanks. (See Figures 1, 2, and 3.)

The hood is made of sheet metal and connected to the tank. All designs require a centrifugal fan to exhaust the fumes, ductwork connecting the hood and the fan, and a replacement air system to bring conditioned air into the building to replace the air exhausted.

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In constructing or designing a slot or down draft hood, use the following data:

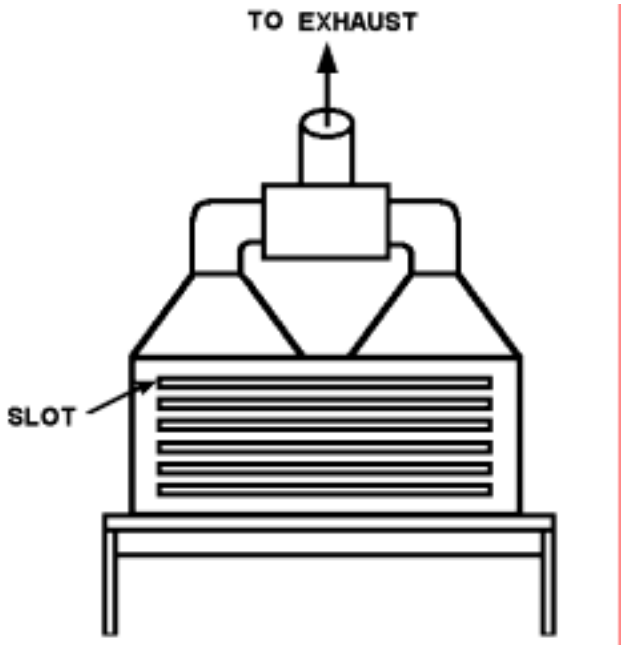

FIGURE 1 -- SLOT HOOD

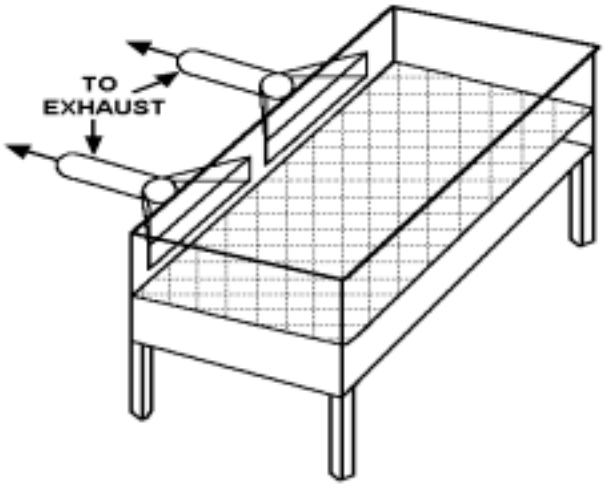

FIGURE 2 -- DOWNDRAFT HOOD

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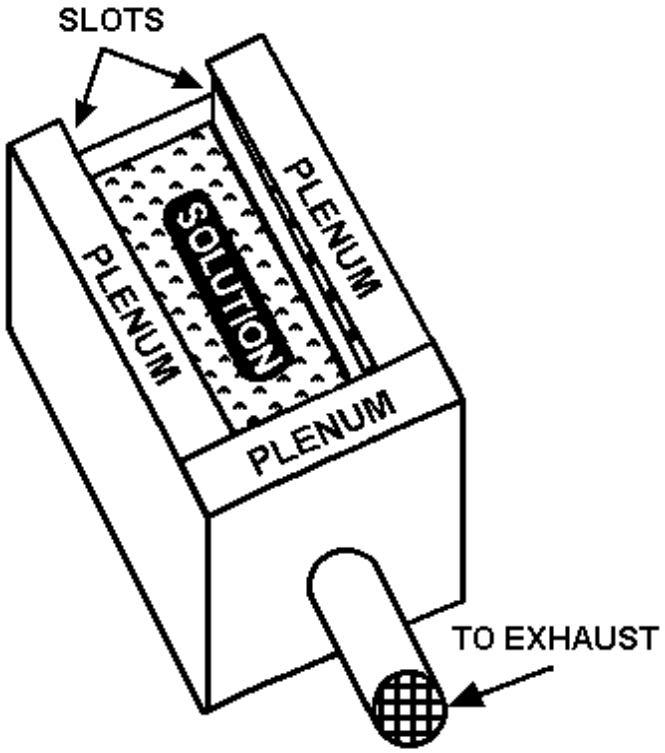

FIGURE 3 -- SLOT HOOD FOR DIP TANK

Safe Work-practices

Workers can lower exposures by decreasing their access to the methylene chloride.[12]

1) Turn on dip tank control system several minutes before entering the stripping area.
2) Avoid unnecessary transferring or moving of the stripping solution.
3) Keep face out of the air stream between the solution-covered furniture and the exhaust system.
4) Keep face out of vapor zone above the stripping solution and the dip tank.
5) Retrieve dropped items with a long handled tool.
6) Keep the solution-recycling system off when not in use. Cover reservoir for recycling system.
7) Cover dip tank when not in use.
8) Provide adequate ventilation for rinse area.

How Can Skin Exposures Be Reduced?

Skin exposures can be reduced by wearing gloves whenever you are in contact with the stripping solution.[13]

1) Two gloves should be worn. The inner glove should be made from polyethylene/ethylene vinyl alcohol (e.g., Silver Shield®, or 4H®). This material, however, does not provide good physical resistance against tears, so an outer glove made from nitrile or neoprene should be worn.
2) Shoulder-length gloves will be more protective.

3) Change gloves before the break-through time occurs. Rotate several pairs of gloves throughout the day. Let the gloves dry in a warm well ventilated area at least over night before reuse.
4) Keep gloves clean by rinsing often. Keep gloves in good condition. Inspect the gloves before use for pin-holes, cracks, thin spots, and stiffer than normal or sticky surfaces.
5) Wear a face shield or goggles to protect face and eyes.

6. What Other Problems Can Occur?

Stripping Solution Temperature

Most manufacturers of stripping solution recommend controlling the solution to a temperature of 70°F. This temperature is required for the wax in the solution to form a vapor barrier on top of the solution to keep the solution from evaporating too quickly. If the temperature is too high, the wax will not form the vapor barrier. If it is too cold, the wax will solidify and separate from the solvent causing increased evaporation. Use a belt heater to heat the solution to the correct temperature. Call your solution manufacturer for the correct temperature for your solution.[14]

Make-Up Air

Air will enter a building in an amount to equal the amount of air exhausted whether or not provision is made for this replacement. If a local exhaust system is added a make-up or replacement air system must be added to replace the air removed. Without a replacement air system, air will enter the building through cracks causing uncontrollable eddy currents. If the building perimeter is tightly sealed, it will prevent the air from entering and severely decrease the amount exhausted from the ventilation system. This will cause the building to be under negative pressure and decrease the performance of the exhaust system.[15]

Dilution Ventilation

With general or dilution ventilation, uncontaminated air is moved through the workroom by means of fans or open windows, which dilutes the pollutants in the air. Dilution ventilation does not provide effective protection to other workers and does not confine the methylene chloride vapors to one area.[16]

Phosgene Poisoning from Use of Kerosene Heaters

Do not use kerosene heaters or other open flame heaters while stripping furniture. Use of kerosene heaters in connection with methylene chloride can create lethal or dangerous concentrations of phosgene. Methylene chloride vapor is mixed with the air used for the combustion of kerosene in kerosene stoves. The vapor thus passes through the flames, coming into close contact with carbon monoxide at high temperatures. Any chlorine formed by decomposition may, under these conditions, react with carbon monoxide and form phosgene.[17]

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[16]*Ibid*.
[17]Gerritsen, W.B. and C.H. Buschmann [1960]. Phosgene Poisoning Caused by the Use of Chemical Paint Removers containing Methylene Chloride in III-Ventilated Rooms Heated by Kerosene Stoves. British Journal of Industrial Medicine 17:187.
[Statutory Authority: RCW 49.17.040, .050, .060, 97-18-062 (Order 97-08), § 296-62-07477, filed 9/2/97, effective 12/1/97.]

PART H
AIR CONTAMINANTS

WAC

296-62-075 Air contaminants.

(1) An employee's exposure to any substance listed in Table 1 of WAC 296-62-07515 shall be limited in accordance with the requirements of WAC 296-62-07501 through 296-62-07513.

(2) The following definitions are applicable to the limits in Table 1.

(a) **Time weighted average (TWA)** is the employee's average airborne exposure to any 8-hour work shift of a 40-hour work week which shall not be exceeded.

(b) **Short term exposure limit (STEL)** is the employee's 15-minute time weighted average exposure which shall not be exceeded at any time during a work day unless another time limit is specified in a parenthetical notation below the limit. If another time period is specified, the time weighted average exposure over that time period shall not be exceeded at any time during the working day.

(c) **Ceiling** is the employee's exposure which shall not be exceeded during any part of the work day. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time over a working day.

(d) The terms **"substance," "air contaminant," and "material"** are equivalent in meaning for WAC 296-62-075 through 296-62-07515.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-075, filed 9/5/97, effective 11/5/97. Statutory Authority: Chapter 49.17 RCW. 89-15-002 (Order 89-06), 296-62-075, filed 7/6/89, effective 8/7/89; Order 73-3, 296-62-075, filed 5/7/73.]

WAC 296-62-07501 Airborne contaminants.

(1) Permissible exposure limits (PELs) refer to airborne concentrations of substances without regard to the use of respiratory protection and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Because of wide variation in individual susceptibility, however, a small percentage of workers may experience discomfort from some substances at concentrations at or below the permissible limit, a smaller percentage may be affected more seriously by aggravation of a preexisting condition or by development of an occupational illness.

(2) Permissible exposure limits refer to time-weighted concentrations for an 8-hour workday within a 40-hour workweek which shall not be exceeded.

(a) The cumulative time-weighted average exposure for an 8-hour work shift shall be computed as follows:

WAC 296-62-07501 (Cont.)

$$E = \frac{C_aT_a + C_bT_b + \ldots + C_nT_n}{8}$$

where:

E is the equivalent exposure for the working shift.

C is the concentration during any period of time T where the concentration remains constant.

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the eight-hour time-weighted average (TWA) limit in Table 1 (see WAC 296-62-07515), for the material involved.

(b) To illustrate the formula, assume that substance A has an 8-hour time-weighted average limit of 100 ppm as noted in Table 1 of WAC 296-62-07515. Assume that an employee is subject to the following exposure:

Two hours exposure at 150 ppm

Two hours exposure at 75 ppm

Four hours exposure at 50 ppm

Substituting this information in the formula, we have

(2x150+2x75+4x50) ÷ 8 = 81.25 p/m

Since 81.25 ppm is less than 100 ppm, the 8-hour time-weighted average limit, the exposure is acceptable.

(3) **Methods of compliance:**

(a) To achieve compliance with these standards, the employer shall determine and implement feasible administrative or engineering controls.

(b) When administrative or engineering controls are not feasible to achieve full compliance, they shall nonetheless be used to reduce exposures to the lowest levels achievable by these controls.

(c) Any control equipment or technical measure utilized for the purpose of complying with WAC 296-62-07501(3) must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used their use shall comply with chapter 296-62 WAC, Part E.

(d) Upon request, the employer shall prepare and submit a written compliance plan to the director. This plan must include a description of the manner in which compliance will be achieved with respect to cited violations of WAC 296-62-07501(3), and shall include proposed abatement methods, anticipated completion dates, and provision for progress reports to be sent to the department.

(4) An employee's exposure to any substance in Table 1 (see WAC 296-62-07515) which does not have a ceiling or a specified short-term exposure limit (STEL) shall not exceed the generic STEL which is computed by multiplying the applicable eight-hour time-weighted average (TWA) for the substance by the appropriate multiplier listed below.

WAC 296-62-07501 (Cont.)

Eight-hour TWA	Multiplier
PEL > 0-1	(ppm or mg/M^3) X 3
PEL > 1-10	(ppm or mg/M^3) X 2
PEL > 10-100	(ppm or mg/M^3) X 1.5
PEL > 100-1000	(ppm or mg/M^3) X 1.25
PEL > 1000	(ppm or mg/M^3) X 1

(5) Permissible limits are based on the best available information from industrial experience, from experimental human and animal studies, and, when possible, from a combination of the three. The basis on which the values are established may differ from substance to substance; protection against impairment of health may be a guiding factor for some, whereas reasonable freedom from irritation, narcosis, nuisance or other forms of stress may form the basis for others.

(6) The limits based on physical irritation shall be considered no less binding than those based on physical impairment. There is increasing evidence that physical irritation may initiate, promote or accelerate physical impairment through interaction with other chemical or biologic agents.

(7) In spite of the fact that serious injury is not believed likely as a result of exposure to the permissible limit concentrations, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical.

(8) These limits are intended for use in the practice of industrial hygiene and should be interpreted and applied only by a technically qualified person.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20), § 296-62-07501, filed 06/05/02, effective 08/01/02. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07501, filed 9/5/97, effective 11/5/97. Statutory Authority: Chapter 49.17 RCW. 89-15-002 (Order 89-06), 296-62-07501, filed 7/6/89, effective 8/7/89. Statutory Authority: RCW 49.17.040 and 49.17.050. 82-03-023 (Order 82-1), 296-62-07501, filed 1/15/82. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-015 (Order 81-20), 296-62-07501, filed 7/27/81; 80-11-010 (Order 80-14), 296-62-07501, filed 8/8/80; Order 73-3, 296-62-07501, filed 5/7/73.]

WAC 296-62-07503 Ceiling vs. time-weighted average limits.

(1) Although the time-weighted average concentration provides the most satisfactory, practical way of monitoring airborne agents for compliance with the limits, there are certain substances for which it is inappropriate. In the latter group are substances which are predominantly fast acting and whose permissible limit is based on this particular response. Substances with this type of response are controlled by a ceiling limit that shall not be exceeded during any part of the work day. It is implicit in these definitions that the manner of sampling to determine compliance with the limits for each group must differ; a single brief sample, that is applicable to a ceiling limit, is not appropriate to the time-weighted limit; here, a sufficient number of samples are needed to determine a time-weighted average concentration throughout a complete cycle of operations or throughout the work shift.

(2) Whereas the ceiling limit places a definite boundary which concentrations shall not be permitted to exceed, the time-weighted average limit requires an explicit limit to the excursions that are permissible above the listed values. The magnitude of these excursions are limited by an appropriate factor shown in WAC 296-62-07501(4).

[Statutory Authority: Chapter 49.17 RCW. 89-15-002 (Order 89-06), 296-62-07503, filed 7/6/89, effective 8/7/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 80-11-010 (Order 80-14), 296-62-07503, filed 8/8/80; Order 73-3, 296-62-07503, filed 5/7/73.]

WAC 296-62-07505 "Skin" notation. Listed substances marked with an "X" in the "skin" column of Table 1 refer to the potential contribution to the overall exposure by the cutaneous route including mucous membranes and eye, either by airborne, or more particularly, by direct contact with the substance. Vehicles can alter skin absorption. Measures for the prevention of cutaneous absorption so that the permissible limit is not invalidated shall be taken. Such measures may include the use of gloves, coveralls, goggles, or other appropriate personal protective equipment, engineering controls or other work practices.
[Statutory Authority: Chapter 49.17 RCW. 89-15-002 (Order 89-06), 296-62-07505, filed 7/6/89, effective 8/7/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 80-11-010 (Order 80-14), 296-62-07505, filed 8/8/80; Order 73-3, 296-62-07505, filed 5/7/73.]

WAC 296-62-07507 Mixtures. Special consideration shall be given to assessing the health hazards associated with exposure to mixtures of two or more substances which have similar health effects.

(1) In case of a mixture of air-contaminants compute the equivalent exposure as follows:

$$E_m = \frac{C_1}{L_1} + \frac{C_2}{L_2} + \ldots + \frac{C_n}{L_n}$$

Where:

E_m is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that contaminant, from Table 1 or 2.

The value of E_m shall not exceed unity (1).

(2) To illustrate the formula consider the following exposures:

Substance	Actual concentration of 8-hour exposure (ppm)	8-hr TWA PEL (ppm)
B	500	1000
C	45	200
D	40	200

Substituting in the formula, we have:
$E_m = 500 \div 1{,}000 + 45 \div 200 + 4 \div 200$
$E_m = 0.500 + 0.225 + 0.200$
$E_m = 0.925$

Since E_m is less than unity (1), the exposure combination is within acceptable limits.
[Statutory Authority: Chapter 49.17 RCW. 90-03-029 (Order 89-20), 296-62-07507, filed 1/11/90, effective 2/26/90; 89-15-002 (Order 89-06), 296-62-07507, filed 7/6/89, effective 8/7/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 80-11-010 (Order 80-14), 296-62-07507, filed 8/8/80; Order 73-3, 296-62-07507, filed 5/7/73.]

WAC 296-62-07509 Nuisance dusts.

(1) In contrast to fibrogenic dusts which cause scar tissue to be formed in lungs when inhaled in excessive amounts, so-called "nuisance" dusts have a long history of little adverse effect on lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. The nuisance dusts have also been called (biologically) "inert" dusts, but the latter term is inappropriate to the extent that there is no dust which does not evoke some cellular response in the lung when inhaled in sufficient amount. However, the lung-tissue reaction caused by inhalation of nuisance dusts has the following characteristics:

(a) The architecture of the air spaces remains intact,

WAC 296-62-07509 (Cont.)

(b) Collagen (scar tissue) is not formed to a significant extent,

(c) The tissue reaction is potentially reversible.

(2) Excessive concentrations of nuisance dusts in the workroom air may seriously reduce visibility, may cause unpleasant deposits in the eyes, ears and nasal passages, or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by the rigorous skin cleansing procedures necessary for their removal.

(3) A permissible limit of 10 milligrams per cubic meter, of total dust < 1% SiO2, or 5.0 mg/m3, respirable fraction, time weighted average, is mandatory for substances in these categories and for which no specific permissible limits have been assigned. This limit does not apply to those substances which may cause physiologic impairment at lower concentrations but for which a threshold limit has not yet been adopted.

(4) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name, are covered by the particulate not otherwise regulated (PNOR) limit in Table 1: Limits for air contaminants, except: The exemption specified in subsection (3) of this section.

[Statutory Authority: Chapter 49.17 RCW. 93-01-067 (Order 92-15), 296-62-07509, filed 12/11/92, effective 1/15/93. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 80-11-010 (Order 80-14), 296-62-07509, filed 8/8/80; Order 73-3, 296-62-07509, filed 5/7/73.]

WAC 296-62-07510 Total particulate. Total particulate exposure shall not exceed a permissible limit of 10 milligrams per cubic meter (mg/M^3) of air for total dust or 5 milligrams per cubic meter (mg/M^3) for respirable dust. The use of this eight-hour time-weighted-average exposure limit does not preclude the application of other applicable limits in WAC 296-62-075 through 296-62-07515. Nor does it preclude the use of WAC 296-62-060 when substances not specifically listed in Table 1 are found to require a lower limit. This section does, however, limit the combined total concentration of all particulate contaminants whether or not specifically listed in Table 1.

[Statutory Authority: RCW 49.17.040, [49.17.] 050 and [49.17.]060. 97-19-014, 296-62-07510, filed 9/5/97, effective 11/5/97. Statutory Authority: Chapter 49.17 RCW. 89-15-002 (Order 89-06), 296-62-07510, filed 7/6/89, effective 8/7/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 80-11-010 (Order 80-14), 296-62-07510, filed 8/8/80.]

WAC 296-62-07511 Simple asphyxiants. "Inert" gases or vapors. A number of gases and vapors when present in high concentrations in air act primarily as simple asphyxiants without other significant physiologic effects. A PEL may not be established for each simple asphyxiant because the limiting factor is the available oxygen. The minimal oxygen content shall be 19.5 percent by volume under normal atmospheric pressure (equivalent to a partial pressure, $p0_2$ of 148 mm Hg). Atmospheres deficient in 0_2do not provide adequate warning and most simple asphyxiants are odorless. Several simple asphyxiants present an explosion hazard. Account shall be taken of this factor in limiting the concentration of the asphyxiant.

[Statutory Authority: Chapter 49.17 RCW. 89-15-002 (Order 89-06), 296-62-07511, filed 7/6/89, effective 8/7/89. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 80-11-010 (Order 80-14), 296-62-07511, filed 8/8/80; Order 73-3, 296-62-07511, filed 5/7/73.]

WAC 296-62-07513 Physical factors. It is recognized that such physical factors as heat, ultraviolet and ionizing radiation, humidity, abnormal pressure and the like may place added stress on the body so that the effects from exposure at a permissible limit may be altered. Most of these stresses act adversely to increase the toxic response of a substance. Although most permissible limits have built-in safety factors to guard against adverse effects to moderate deviations from normal environments, the safety factors of most substances are not of such a magnitude as to take care of gross deviations.

[Statutory Authority: RCW 49.17.040, 49.17.050, and 49.17.240. 80-11-010 (Order 80-14), 296-62-07513, filed 8/8/80; Order 73-3, 296-62-07513, filed 5/7/73.]

PART I
AIR CONTAMINANTS (SPECIFIC)

WAC 296-62-07517 Reserved.

[Statutory Authority: Chapter 49.17 RCW. 90-09-026 (Order 90-01), 296-62-07517, filed 4/10/90, effective 5/25/90; 87-24-051 (Order 87-24), 296-62-07517, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07517, filed 4/27/87. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), 296-62-07517, filed 8/27/81; 81-16-015 (Order 81-20), 296-62-07517, filed 7/27/81; 80-11-010 (Order 80-14), 296-62-07517, filed 8/8/80; Order 77-12, 296-62-07517, filed 7/11/77; Order 73-3, 296-62-07517, filed 5/7/73.]

WAC 296-62-07519 Thiram.

(1) **Scope and application.** This section applies to occupational exposure to thiram (tetramethylthiuram disulfide), in addition to those requirements listed in WAC 296-62-07515. Nothing in this section shall preclude the application of other appropriate standards and regulations to minimize worker exposure to thiram.

WAC 296-62-07519 (Cont.)

(2) **Definitions.** The following definitions are applicable to this section:

(a) **Clean** - the absence of dirt or materials which may be harmful to a worker's health.

(b) **Large seedlings** - those seedlings of such size, either by length or breadth, that it is difficult to avoid contact of the thiram treated plant with the mouth or face during planting operations.

(3) **General requirements.**

(a) Workers should not be allowed to work more than five days in any seven day period with or around the application of thiram or thiram treated seedlings.

(b) Washing and worker hygiene.

(i) Workers shall wash their hands prior to eating or smoking at the close of work.

(ii) Warm (at least 85°F, 29.4°C) wash water and single use hand wiping materials shall be provided for washing.

(iii) The warm water and hand wiping materials shall be at fixed work locations or at the planting unit.

(iv) Where warm water is not available within 15 minutes travel time, nonalcoholic based waterless hand cleaner shall be provided.

(v) Every planter or nursery worker shall be advised to bathe or shower daily.

(vi) The inside of worker carrying vehicles shall be washed or vacuumed and wiped down at least weekly during the period of thiram use.

(c) Personal protective measures.

(i) Clothing shall be worn by workers to reduce skin contact with thiram to the legs, arms and torso.

(ii) For those workers who have thiram skin irritations, exposed areas of the body shall be protected by a suitable barrier cream.

(iii) Clothing worn by workers shall be washed or changed at least every other day.

(iv) Only impervious gloves may be worn by workers.

(v) Workers hands should be clean of thiram before placing them into gloves.

(vi) Thiram applicators shall be provided with and use respiratory protection in accordance with WAC 296-62-071, disposable coveralls or rubber slickers or other impervious clothing, rubberized boots, head covers and rubberized gloves.

(vii) Nursery workers, other than applicators, who are likely to be exposed to thiram shall be provided with and use disposable coveralls or rubber slickers or other impervious clothing, impervious footwear and gloves, and head covers in accordance with WAC 296-800-160, unless showers have been provided and are used.

WAC 296-62-07519 (Cont.)

(viii) Eye protection according to WAC 296-800-160, shall be provided and worn by workers who may be exposed to splashes of thiram during spraying, plug bundling, belt line grading and plugging or other operations.

(ix) Item (viii) of this subdivision need not be complied with where pressurized emergency eye wash fountains are within 10 seconds travel time of the work location. (Approved respirator - see WAC 296-62-071.)

(x) A dust mask shall be worn, when planting large seedlings, to avoid mouth and face contact with the thiram treated plant unless equally effective measures or planting practices have been established.

(d) Food handling.

(i) Food snacks, beverages, smoking materials, or any other item which is consumed shall not be stored or consumed in the packing area of the nursery.

(ii) Worker carrying vehicles shall have a clean area for carrying lunches.

(iii) The clean area of the vehicle shall be elevated from the floor and not used to carry other than food or other consumable items.

(iv) The carrying of lunches, food or other consumable items in tree planting bags is prohibited.

(v) Care shall be taken to insure that worker exposure to thiram spray, including downwind driftings, is minimized or eliminated.

(vi) When bags that contained thiram or thiram treated seedlings are burned, prevent worker exposure to the smoke.

(e) Thiram use and handling.

(i) Thiram treated seedlings shall be allowed to dry or stabilize prior to packing.

(ii) Seedlings shall be kept moist during packing and whenever possible during planting operations.

(iii) Floors, where thiram is used, shall not be dry swept but instead vacuumed, washed or otherwise cleaned at least daily.

(iv) Silica chips used to cover thiram treated seedling plugs shall be removed at the nursery.

(f) Training.

(i) Each worker engaged in operations where exposure to thiram may occur shall be provided training on the hazards of thiram, as well as the necessary precautions for its safe use and handling.

(ii) The training shall include instruction in:

(A) The nature of the health hazard(s) from exposure to thiram including specifically the potential for alcohol intolerance, drug interaction, and skin irritation;

WAC 296-62-07519 (Cont.)

(B) The specific nature of operations which could result in exposure to thiram and the necessary protective steps;

(C) The purpose for, proper use, and limitations of protective devices including respirators and clothing;

(D) The necessity for and requirements of good personal hygiene; and

(E) A review of the thiram rules at the worker's first training and indoctrination, and annually thereafter.

(4) **Effective date.** This standard shall become effective 30 days after being filed with the code reviser.
[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07519, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-16-016 (Order 81-19), 296-62-07519, filed 7/27/81.]

WAC 296-62-07521 Lead.

(1) **Scope and application.**

(a) This section applies to all occupational exposure to lead, except as provided in subdivision (1)(b).

(b) This section does not apply to the construction industry or to agricultural operations covered by chapter 296-306 WAC.

(2) Definitions as applicable to this part.

(a) **"Action level"** - employee exposure, without regard to the use of respirators, to an airborne concentration of lead of thirty micrograms per cubic meter of air (30 $\mu g/m^3$) averaged over an eight-hour period.

(b) **"Director"** - the director of the department of labor and industries.

(c) **"Lead"** - metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.

(3) **General requirements.**

(a) Employers will assess the hazards of lead in the work place and provide information to the employees about the hazards of the lead exposures to which they may be exposed.

(b) Information provided shall include:

(i) Exposure monitoring (including employee notification);

(ii) Written compliance programs;

(iii) Respiratory protection programs;

(iv) Personnel protective equipment and housekeeping;

(v) Medical surveillance and examinations;

(vi) Training requirements;

WAC 296-62-07521 (Cont.)

(vii) Recordkeeping requirements.

(4) **Permissible exposure limit (PEL).**

(a) The employer shall assure that no employee is exposed to lead at concentrations greater than fifty micrograms per cubic meter of air (50 µg/m^3) averaged over an eight-hour period.

(b) If an employee is exposed to lead for more than eight hours in any work day, the permissible exposure limit, as a time weighted average (TWA) for that day, shall be reduced according to the following formula:

Maximum permissible limit (in µg/m^3) = 400 ÷ hours worked in the day.

(c) When respirators are used to supplement engineering and work practice controls to comply with the PEL and all the requirements of subsection (7) have been met, employee exposure, for the purpose of determining whether the employer has complied with the PEL, may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily TWA exposure.

(5) **Exposure monitoring.**

(a) General.

(i) For the purposes of subsection (5), employee exposure is that exposure which would occur if the employee were not using a respirator.

(ii) With the exception of monitoring under subdivision (5)(c), the employer shall collect full shift (for at least seven continuous hours) personal samples including at least one sample for each shift for each job classification in each work area.

(iii) Full shift personal samples shall be representative of the monitored employee's regular, daily exposure to lead.

(b) Initial determination. Each employer who has a workplace or work operation covered by this standard shall determine if any employee may be exposed to lead at or above the action level.

(c) Basis of initial determination.

(i) The employer shall monitor employee exposures and shall base initial determinations on the employee exposure monitoring results and any of the following, relevant considerations:

(A) Any information, observations, or calculations which would indicate employee exposure to lead;

(B) Any previous measurements of airborne lead; and

(C) Any employee complaints of symptoms which may be attributable to exposure to lead.

WAC 296-62-07521 (Cont.)

(ii) Monitoring for the initial determination may be limited to a representative sample of the exposed employees who the employer reasonably believes are exposed to the greatest airborne concentrations of lead in the workplace.

(iii) Measurements of airborne lead made in the preceding twelve months may be used to satisfy the requirement to monitor under item (5)(c)(i) if the sampling and analytical methods used meet the accuracy and confidence levels of subdivision (5)(i) of this section.

(d) Positive initial determination and initial monitoring.

(i) Where a determination conducted under subdivision (5)(b) and (5)(c) of this section shows the possibility of any employee exposure at or above the action level, the employer shall conduct monitoring which is representative of the exposure for each employee in the workplace who is exposed to lead.

(ii) Measurements of airborne lead made in the preceding twelve months may be used to satisfy this requirement if the sampling and analytical methods used meet the accuracy and confidence levels of subdivision (5)(i) of this section.

(e) Negative initial determination. Where a determination, conducted under subdivisions (5)(b) and (5)(c) of this section is made that no employee is exposed to airborne concentrations of lead at or above the action level, the employer shall make a written record of such determination. The record shall include at least the information specified in subdivision (5)(c) of this section and shall also include the date of determination, location within the worksite, and the name and social security number of each employee monitored.

(f) Frequency.

(i) If the initial monitoring reveals employee exposure to be below the action level the measurements need not be repeated except as otherwise provided in subdivision (5)(g) of this section.

(ii) If the initial determination or subsequent monitoring reveals employee exposure to be at or above the action level but below the permissible exposure limit the employer shall repeat monitoring in accordance with this subsection at least every six months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least seven days apart, are below the action level at which time the employer may discontinue monitoring for that employee except as otherwise provided in subdivision (5)(g) of this section.

(iii) If the initial monitoring reveals that employee exposure is above the permissible exposure limit the employer shall repeat monitoring quarterly. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least seven days apart, are below the PEL but at or above the action level at which time the employer shall repeat monitoring for that employee at the frequency specified in item (5)(f)(ii), except as otherwise provided in subdivision (5)(g) of this section.

(g) Additional monitoring. Whenever there has been a production, process, control or personnel change which may result in new or additional exposure to lead, or whenever the employer has any other reason to suspect a change which may result in new or additional exposures to lead, additional monitoring in accordance with this subsection shall be conducted.

WAC 296-62-07521 (Cont.)

(h) Employee notification.

(i) Within five working days after the receipt of monitoring results, the employer shall notify each employee in writing of the results which represent that employee's exposure.

(ii) Whenever the results indicate that the representative employee exposure, without regard to respirators, exceeds the permissible exposure limit, the employer shall include in the written notice a statement that the permissible exposure limit was exceeded and a description of the corrective action taken or to be taken to reduce exposure to or below the permissible exposure limit.

(i) Accuracy of measurement. The employer shall use a method of monitoring and analysis which has an accuracy (to a confidence level of ninety-five percent) of not less than plus or minus twenty percent for airborne concentrations of lead equal to or greater than 30 µg/m^3.

(6) **Methods of compliance.**

(a) Engineering and work practice controls.

(i) Where any employee is exposed to lead above the permissible exposure limit for more than thirty days per year, the employer shall implement engineering and work practice controls (including administrative controls) to reduce and maintain employee exposure to lead in accordance with the implementation schedule in Table I below, except to the extent that the employer can demonstrate that such controls are not feasible. Wherever the engineering and work practice controls which can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest feasible level and shall supplement them by the use of respiratory protection which complies with the requirements of subsection (7) of this section.

(ii) Where any employee is exposed to lead above the permissible exposure limit, but for thirty days or less per year, the employer shall implement engineering controls to reduce exposures to 200 µg/m^3, but thereafter may implement any combination of engineering, work practice (including administrative controls), and respiratory controls to reduce and maintain employee exposure to lead to or below 50 µg/m^3.

TABLE 1

Industry	**Compliance dates[1] (50 µg/m^3)**
Lead chemicals, secondary copper smelting	July 19, 1996
Nonferrous foundries	July 19, 1996[2]
Brass and bronze ingot manufacture.	6 years[3]

[1]Calculated by counting from the date the stay on implementation of subsection (6)(a) was lifted by the U.S. Court of Appeals for the District of Columbia, the number of years specified in the 1978 lead standard and subsequent amendments for compliance with the PEL of 50 µg/m^3 for exposure to airborne concentrations of lead levels for the particular industry.

WAC 296-62-07521 (Cont.)

[2] Large nonferrous foundries (20 or more employees) are required to achieve the PEL of 50 µg/m^3 by means of engineering and work practice controls. Small nonferrous foundries (fewer than 20 employees) are required to achieve an 8-hour TWA of 75 µg/m^3 by such controls.

[3]Expressed as the number of years from the date on which the Court lifts the stay on the implementation of subsection (6)(a) for this industry for employers to achieve a lead in air concentration of 75 µg/m^3. Compliance with subsection (6) in this industry is determined by a compliance directive that incorporates elements from the settlement agreement between OSHA and representatives of the industry.

(b) Respiratory protection. Where engineering and work practice controls do not reduce employee exposure to or below the 50 µg/m^3 permissible exposure limit, the employer shall supplement these controls with respirators in accordance with subsection (7).

(c) Compliance program.

(i) Each employer shall establish and implement a written compliance program to reduce exposures to or below the permissible exposure limit, and interim levels if applicable, solely by means of engineering and work practice controls in accordance with the implementation schedule in subdivision (6)(a).

(ii) Written plans for these compliance programs shall include at least the following:

(A) A description of each operation in which lead is emitted; e.g., machinery used, material processed, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices;

(B) A description of the specific means that will be employed to achieve compliance, including engineering plans and studies used to determine methods selected for controlling exposure to lead;

(C) A report of the technology considered in meeting the permissible exposure limit;

(D) Air monitoring data which documents the source of lead emissions;

(E) A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment, construction contracts, etc.;

(F) A work practice program which includes items required under subsections (8), (9) and (10) of this regulation;

(G) An administrative control schedule required by subdivision (6)(f), if applicable; and

(H) Other relevant information.

(iii) Written programs shall be submitted upon request to the director, and shall be available at the worksite for examination and copying by the director, any affected employee or authorized employee representatives.

(iv) Written programs shall be revised and updated at least every six months to reflect the current status of the program.

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(d) Mechanical ventilation.

(i) When ventilation is used to control exposure, measurements which demonstrate the effectiveness of the system in controlling exposure, such as capture velocity, duct velocity, or static pressure shall be made at least every three months. Measurements of the system's effectiveness in controlling exposure shall be made within five days of any change in production, process, or control which might result in a change in employee exposure to lead.

(ii) Recirculation of air. If air from exhaust ventilation is recirculated into the workplace, the employer shall assure that (A) the system has a high efficiency filter with reliable back-up filter; and (B) controls to monitor the concentration of lead in the return air and to bypass the recirculation system automatically if it fails are installed, operating, and maintained.

(e) Administrative controls. If administrative controls are used as a means of reducing employees TWA exposure to lead, the employer shall establish and implement a job rotation schedule which includes:

(i) Name or identification number of each affected employee;

(ii) Duration and exposure levels at each job or work station where each affected employee is located; and

(iii) Any other information which may be useful in assessing the reliability of administrative controls to reduce exposure to lead.

(7) **Respiratory protection.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods necessary to install or implement engineering or work-practice controls;

(ii) Work operations for which engineering and work-practice controls are not sufficient to reduce exposures to or below the permissible exposure limit;

(iii) Periods when an employee requests a respirator.

(b) Respirator program.

(i) The employer must implement a respiratory protection program as required by Chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(ii) If an employee has difficulty breathing during fit testing or respirator use, the employer must provide the employee with a medical examination as required by subsection (11)(c)(ii)(C) of this section to determine whether or not the employee can use a respirator while performing the required duty.

(c) Respirator selection.

(i) The employer must select the appropriate respirator or combination of respirators from Table II of this section.

(ii) The employer must provide a powered air-purifying respirator instead of the respirator specified in Table II of this section when an employee chooses to use this type of respirator and that such a respirator provides adequate protection to the employee.

TABLE II
RESPIRATORY PROTECTION FOR LEAD AEROSOLS

Airborne Concentration of Lead or Condition of Use	Required Respirator[1]
Not in excess of 0.5 mg/m^3 (10 x PEL).	Half-mask, air-purifying respirator equipped with high efficiency filters.[2,3]
Not in excess of 2.5 mg/m^3 (50 x PEL).	Full facepiece, air-purifying respirator with high efficiency filters.[3]
Not in excess of 50 mg/m^3 (1000 x PEL).	(1) Any powered, air-purifying respirator with high efficiency filters[3] , or (2) Half-mask supplied-air respirator operated in positive-pressure mode.[2]
Not in excess of 100 mg/m^3 (2000 x PEL).	Supplied-air respirator with full facepiece, hood, helmet, or suit, operated in positive-pressure mode.
Greater than 100 mg/m^3, unknown concentration or fire fighting	Full facepiece, self-contained breathing apparatus operated in positive-pressure mode.

Note:

[1] Respirators specified for high concentrations can be used at lower concentrations of lead.

[2] Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.

[3] A high efficiency particulate filter means 99.97 percent efficient against 0.3 micron size particles.

(8) **Protective work clothing and equipment.**

(a) Provision and use. If an employee is exposed to lead above the PEL, without regard to the use of respirators or where the possibility of skin or eye irritation exists, the employer shall provide at no cost to the employee and assure that the employee uses appropriate protective work clothing and equipment such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, hats, and shoes or disposable shoe coverlets; and

(iii) Face shields, vented goggles, or other appropriate protective equipment which complies with WAC 296-800-160.

(b) Cleaning and replacement.

(i) The employer shall provide the protective clothing required in subdivision (8)(a) of this section in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to a respirator are over 200 µg/m^3 of lead as an eight-hour TWA.

(ii) The employer shall provide for the cleaning, laundering, or disposal of protective clothing and equipment required by subdivision (8)(a) of this section.

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(iii) The employer shall repair or replace required protective clothing and equipment as needed to maintain their effectiveness.

(iv) The employer shall assure that all protective clothing is removed at the completion of a work shift only in change rooms provided for that purpose as prescribed in subdivision (10)(b) of this section.

(v) The employer shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change-room which prevents dispersion of lead outside the container.

(vi) The employer shall inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to lead.

(vii) The employer shall assure that the containers of contaminated protective clothing and equipment required by subdivision (8)(b)(v) are labeled as follows:

CAUTION: CLOTHING CONTAMINATED WITH LEAD.
DO NOT REMOVE DUST
BY BLOWING OR SHAKING.
DISPOSE OF LEAD CONTAMINATED WASH WATER
IN ACCORDANCE WITH APPLICABLE
LOCAL, STATE, OR FEDERAL REGULATIONS.

(viii) The employer shall prohibit the removal of lead from protective clothing or equipment by blowing, shaking, or any other means which disperses lead into the air.

(9) **Housekeeping.**

(a) Surfaces. All surfaces shall be maintained as free as practicable of accumulations of lead.

(b) Cleaning floors.

(i) Floors and other surfaces where lead accumulates may not be cleaned by the use of compressed air.

(ii) Shoveling, dry or wet sweeping, and brushing may be used only where vacuuming or other equally effective methods have been tried and found not to be effective.

(c) Vacuuming. Where vacuuming methods are selected, the vacuums shall be used and emptied in a manner which minimizes the reentry of lead into the workplace.

(10) **Hygiene facilities and practices.**

(a) The employer shall assure that in areas where employees are exposed to lead above the PEL, without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, except in change rooms, lunchrooms, and showers required under subdivision (10)(b) through (10)(d) of this section.

(b) Change rooms.

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(i) The employer shall provide clean change rooms for employees who work in areas where their airborne exposure to lead is above the PEL, without regard to the use of respirators.

(ii) The employer shall assure that change rooms are equipped with separate storage facilities for protective work clothing and equipment and for street clothes which prevent cross-contamination.

(c) Showers.

(i) The employer shall assure that employees who work in areas where their airborne exposure to lead is above the PEL, without regard to the use of respirators, shower at the end of the work shift.

(ii) The employer shall provide shower facilities in accordance with WAC 296-24-12009.

(iii) The employer shall assure that employees who are required to shower pursuant to item (10)(c)(i) do not leave the workplace wearing any clothing or equipment worn during the work shift.

(d) Lunchrooms.

(i) The employer shall provide lunchroom facilities for employees who work in areas where their airborne exposure to lead is above the PEL, without regard to the use of respirators.

(ii) The employer shall assure that lunchroom facilities have a temperature controlled, positive pressure, filtered air supply, and are readily accessible to employees.

(iii) The employer shall assure that employees who work in areas where their airborne exposure to lead is above the PEL without regard to the use of a respirator wash their hands and face prior to eating, drinking, smoking or applying cosmetics.

(iv) The employer shall assure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface lead dust has been removed by vacuuming, downdraft booth, or other cleaning method.

(e) Lavatories. The employer shall provide an adequate number of lavatory facilities which comply with WAC 296-800-230.

(11) **Medical surveillance.**

(a) General.

(i) The employer shall institute a medical surveillance program for all employees who are or may be exposed above the action level for more than thirty days per year.

(ii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.

(iii) The employer shall provide the required medical surveillance including multiple physician review under item (11)(c)(iii) without cost to employees and at a reasonable time and place.

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(b) Biological monitoring.

(i) Blood lead and ZPP level sampling and analysis. The employer shall make available biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels to each employee covered under item (11)(a)(i) of this section on the following schedule:

(A) At least every six months to each employee covered under item (11)(a)(i) of this section;

(B) At least every two months for each employee whose last blood sampling and analysis indicated a blood lead level at or above 40 µg/100 g of whole blood. This frequency shall continue until two consecutive blood samples and analyses indicate a blood lead level below 40 µg/100 g of whole blood; and

(C) At least monthly during the removal period of each employee removed from exposure to lead due to an elevated blood lead level.

(ii) Follow-up blood sampling tests. Whenever the results of a blood lead level test indicate that an employee's blood lead level exceeds the numerical criterion for medical removal under item (12)(a)(i)(A), the employer shall provide a second (follow-up) blood sampling test within two weeks after the employer receives the results of the first blood sampling test.

(iii) Accuracy of blood lead level sampling and analysis. Blood lead level sampling and analysis provided pursuant the this section shall have an accuracy (to a confidence level of ninety-five percent) within plus or minus fifteen percent or 6 µg/100 ml, whichever is greater, and shall be conducted by a laboratory licensed by the Center for Disease Control (CDC), United States Department of Health, Education and Welfare or which has received a satisfactory grade in blood lead proficiency testing from CDC in the prior twelve months.

(iv) Employee notification. Within five working days after the receipt of biological monitoring results, the employer shall notify in writing each employee whose blood lead level exceeds 40 µg/100 g: (A) of that employee's blood lead level and (B) that the standard requires temporary medical removal with medical removal protection benefits when an employee's blood lead level exceeds the numerical criterion for medical removal under item (12)(a)(i) of this section.

(c) Medical examinations and consultations.

(i) Frequency. The employer shall make available medical examinations and consultations to each employee covered under item (11)(a)(i) of this section on the following schedule:

(A) At least annually for each employee for whom a blood sampling test conducted at any time during the preceding twelve months indicated a blood lead level at or above 40 µg/100 g;

(B) Prior to assignment for each employee being assigned for the first time to an area in which airborne concentrations of lead are at or above the action level;

(C) As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or

past exposure to lead on the employee's ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during use; and

(D) As medically appropriate for each employee either removed from exposure to lead due to a risk of sustaining material impairment to health, or otherwise limited pursuant to a final medical determination.

(ii) Content. Medical examinations made available pursuant to subitems (11)(c)(i)(A) through (B) of this section shall include the following elements:

(A) A detailed work history and a medical history, with particular attention to past lead exposure (occupational and nonoccupational), personal habits (smoking, hygiene), and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems;

(B) A thorough physical examination, with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used;

(C) A blood pressure measurement;

(D) A blood sample and analysis which determines:

(I) Blood lead level;

(II) Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology;

(III) Zinc protoporphyrin;

(IV) Blood urea nitrogen; and

(V) Serum creatinine;

(E) A routine urinalysis with microscopic examination; and

(F) Any laboratory or other test which the examining physician deems necessary by sound medical practice.

The content of medical examinations made available pursuant to subitems (11)(c)(i)(C) through (D) of this section shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility.

(iii) Multiple physician review mechanism.

(A) If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under this section, the employee may designate a second physician:

(I) To review any findings, determinations or recommendations of the initial physician; and

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(II) To conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

(B) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation pursuant to this section. The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen days after receipt of the foregoing notification, or receipt of the initial physician's written opinion, whichever is later:

(I) The employee informing the employer that he or she intends to seek a second medical opinion, and

(II) The employee initiating steps to make an appointment with a second physician.

(C) If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve any disagreement.

(D) If the two physicians have been unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician:

(I) To review any findings, determinations or recommendations of the prior physicians; and

(II) To conduct such examinations, consultations, laboratory tests and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(E) The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(iv) Information provided to examining and consulting physicians.

(A) The employer shall provide an initial physician conducting a medical examination or consultation under this section with the following information:

(I) A copy of this regulation for lead including all appendices;

(II) A description of the affected employee's duties as they relate to the employee's exposure;

(III) The employee's exposure level or anticipated exposure level to lead and to any other toxic substance (if applicable);

(IV) A description of any personal protective equipment used or to be used;

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(V) Prior blood lead determinations; and

(VI) All prior written medical opinions concerning the employee in the employer's possession or control.

(B) The employer shall provide the foregoing information to a second or third physician conducting a medical examination or consultation under this section upon request either by the second or third physician, or by the employee.

(v) Written medical opinions.

(A) The employer shall obtain and furnish the employee with a copy of a written medical opinion from each examining or consulting physician which contains the following information:

(I) The physician's opinion as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to lead;

(II) Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;

(III) Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a powered air purifying respirator if a physician determines that the employee cannot wear a negative pressure respirator; and

(IV) The results of the blood lead determinations.

(B) The employer shall instruct each examining and consulting physician to:

(I) Not reveal either in the written opinion, or in any other means of communication with the employer, findings, including laboratory results, or diagnoses unrelated to an employee's occupational exposure to lead; and

(II) Advise the employee of any medical condition, occupational or nonoccupational, which dictates further medical examination or treatment.

(vi) Alternate physician determination mechanisms. The employer and an employee or authorized employee representative may agree upon the use of any expeditious alternate physician determination mechanism in lieu of the multiple physician review mechanism provided by this subsection so long as the alternate mechanism otherwise satisfies the requirements contained in this subsection.

(d) Chelation.

(i) The employer shall assure that any person whom he retains, employs, supervises or controls does not engage in prophylactic chelation of any employee at any time.

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(ii) If therapeutic or diagnostic chelation is to be performed by any person in item (11)(d)(i), the employer shall assure that it be done under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring and that the employee is notified in writing prior to its occurrence.

(12) **Medical removal protection.**

(a) Temporary medical removal and return of an employee.

(i) Temporary removal due to elevated blood lead levels.

(A) The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a periodic and a follow-up blood sampling test conducted pursuant to this section indicate that the employee's blood lead level is at or above 60 µg/100 g of whole blood; and

(B) The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that the average of the last three blood sampling tests conducted pursuant to this section (or the average of all blood sampling tests conducted over the previous six months, whichever is longer) indicates that the employee's blood lead level is at or above 50 µg/100 g of whole blood; provided, however, that an employee need not be removed if the last blood sampling test indicates a blood lead level at or below 40 µg/100 g of whole blood.

(ii) Temporary removal due to a final medical determination.

(A) The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a final medical determination results in a medical finding, determination, or opinion that the employee has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the phrase **"final medical determination"** shall mean the outcome of the multiple physician review mechanism or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section.

(C) Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to lead, the employer shall implement and act consistent with the recommendation.

(iii) Return of the employee to former job status.

(A) The employer shall return an employee to his or her former job status:

(I) For an employee removed due to a blood lead level at or above 60 µg/100 g, or due to an average blood lead level at or above 50 µg/100 g, when two consecutive blood sampling tests indicate that the employee's blood lead level is at or below 40 µg/100 g of whole blood;

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(II) For an employee removed due to a final medical determination, when a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(iv) Removal of other employee special protective measure or limitations. The employer shall remove any limitations placed on an employee or end any special protective measures provided to an employee pursuant to a final medical determination when a subsequent final medical determination indicates that the limitations or special protective measures are no longer necessary.

(v) Employer options pending a final medical determination. Where the multiple physician review mechanism, or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

(A) Removal. The employer may remove the employee from exposure to lead, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

(B) Return. The employer may return the employee to his or her former job status, end any special protective measures provided to the employee, and remove any limitations placed upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status, with two exceptions. If:

(I) The initial removal, special protection, or limitation of the employee resulted from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician; or

(II) The employee has been on removal status for the preceding eighteen months due to an elevated blood lead level, then the employer shall await a final medical determination.

(b) Medical removal protection benefits.

(i) Provision of medical removal protection benefits. The employer shall provide to an employee up to eighteen months of medical removal protection benefits on each occasion that an employee is removed from exposure to lead or otherwise limited pursuant to this section.

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(ii) Definition of medical removal protection benefits. For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that the employer shall maintain the earnings, seniority and other employment rights and benefits of an employee as though the employee had not been removed from normal exposure to lead or otherwise limited.

(iii) Follow-up medical surveillance during the period of employee removal or limitation. During the period of time that an employee is removed from normal exposure to lead or otherwise limited, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(iv) Workers' compensation claims. If a removed employee files a claim for workers' compensation payments for a lead-related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for workers' compensation payments received by the employee for treatment related expenses.

(v) Other credits. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program, or receives income from employment with another employer made possible by virtue of the employee's removal.

(vi) Employees whose blood lead levels do not adequately decline within eighteen months of removal. The employer shall take the following measures with respect to any employee removed from exposure to lead due to an elevated blood lead level whose blood lead level has not declined within the past eighteen months of removal so that the employee has been returned to his or her former job status:

(A) The employer shall make available to the employee a medical examination pursuant to this section to obtain a final medical determination with respect to the employee;

(B) The employer shall assure that the final medical determination obtained indicates whether or not the employee may be returned to his or her former job status, and if not, what steps should be taken to protect the employee's health;

(C) Where the final medical determination has not yet been obtained, or once obtained indicates that the employee may not yet be returned to his or her former job status, the employer shall continue to provide medical removal protection benefits to the employee until either the employee is returned to former job status, or a final medical determination is made that the employee is incapable of ever safely returning to his or her former job status.

(D) Where the employer acts pursuant to a final medical determination which permits the return of the employee to his or her former job status despite what would otherwise be an unacceptable blood lead level, later questions concerning removing the employee again shall be decided by a final medical determination. The employer need not automatically remove such an employee pursuant to the blood lead level removal criteria provided by this section.

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(vii) Voluntary removal or restriction of an employee. Where an employer, although not required by this section to do so, removes an employee from exposure to lead or otherwise places limitations on an employee due to the effects of lead exposure on the employee's medical condition, the employer shall provide medical removal protection benefits to the employee equal to that required by item (12)(b)(i) of this section.

(13) **Employee information and training.**

(a) Training program.

(i) Each employer who has a workplace in which there is a potential exposure to airborne lead at any level shall inform employees of the content of Appendices A and B of this regulation.

(ii) The employer shall institute a training program for and assure the participation of all employees who are subject to exposure to lead at or above the action level or for whom the possibility of skin or eye irritation exists.

(iii) The employer shall provide initial training by one hundred eighty days from the effective date for those employees covered by item (13)(a)(ii) on the standard's effective date and prior to the time of initial job assignment for those employees subsequently covered by this subsection.

(iv) The training program shall be repeated at least annually for each employee.

(v) The employer shall assure that each employee is informed of the following:

(A) The content of this standard and its appendices;

(B) The specific nature of the operations which could result in exposure to lead above the action level;

(C) The purpose, proper use, limitations, and other training requirements for respiratory protection as required by chapter 296-62 WAC, Part E;

(D) The purpose and a description of the medical surveillance program, and the medical removal protection program including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females);

(E) The engineering controls and work practices associated with the employee's job assignment;

(F) The contents of any compliance plan in effect; and

(G) Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies and should not be used at all except under the direction of a licensed physician.

(b) Access to information and training materials.

(i) The employer shall make readily available to all affected employees a copy of this standard and its appendices.

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(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to the director.

(iii) In addition to the information required by item (13)(a)(v), the employer shall include as part of the training program, and shall distribute to employees, any materials pertaining to the Occupational Safety and Health Act, the regulations issued pursuant to the act, and this lead standard, which are made available to the employer by the director.

(14) **Signs.**

(a) General.

(i) The employer may use signs required by other statutes, regulations or ordinances in addition to, or in combination with, signs required by this subsection.

(ii) The employer shall assure that no statement appears on or near any sign required by this subsection which contradicts or detracts from the meaning of the required sign.

(b) Signs.

(i) The employer shall post the following warning signs in each work area where the PEL is exceeded:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

(ii) The employer shall assure that signs required by this subsection are illuminated and cleaned as necessary so that the legend is readily visible.

(15) **Recordkeeping.**

(a) Exposure monitoring.

(i) The employer shall establish and maintain an accurate record of all monitoring required in subsection (5) of this section.

(ii) This record shall include:

(A) The date(s), number, duration, location and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure where applicable;

(B) A description of the sampling and analytical methods used and evidence of their accuracy;

(C) The type of respiratory protective devices worn, if any;

(D) Name, social security number, and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent; and

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(E) The environmental variables that could affect the measurement of employee exposure.

(iii) The employer shall maintain these monitoring records for at least forty years or for the duration of employment plus twenty years, whichever is longer.

(b) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by subsection (11) of this section.

(ii) This record shall include:

(A) The name, social security number, and description of the duties of the employee;

(B) A copy of the physician's written opinions;

(C) Results of any airborne exposure monitoring done for that employee and the representative exposure levels supplied to the physician; and

(D) Any employee medical complaints related to exposure to lead.

(iii) The employer shall keep, or assure that the examining physician keeps, the following medical records:

(A) A copy of the medical examination results including medical and work history required under subsection (11) of this section;

(B) A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information; and

(C) A copy of the results of biological monitoring.

(iv) The employer shall maintain or assure that the physician maintains those medical records for at least forty years, or for the duration of employment plus twenty years, whichever is longer.

(c) Medical removals.

(i) The employer shall establish and maintain an accurate record for each employee removed from current exposure to lead pursuant to subsection (12) of this section.

(ii) Each record shall include:

(A) The name and social security number of the employee;

(B) The date on each occasion that the employee was removed from current exposure to lead as well as the corresponding date on which the employee was returned to his or her former job status;

(C) A brief explanation of how each removal was or is being accomplished; and

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(D) A statement with respect to each removal indicating whether or not the reason for the removal was an elevated blood lead level.

(iii) The employer shall maintain each medical removal record for at least the duration of an employee's employment.

(d) Availability.

(i) The employer shall make available upon request all records required to be maintained by subsection (15) of this section to the director for examination and copying.

(ii) Environmental monitoring, medical removal, and medical records required by this subsection shall be provided upon request to employees, designated representatives, and the assistant director in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217. Medical removal records shall be provided in the same manner as environmental monitoring records.

(iii) Upon request, the employer shall make an employee's medical records required to be maintained by this section available to the affected employee or former employee or to a physician or other individual designated by such affected employee or former employees for examination and copying.

(e) Transfer of records.

(i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by subsection (15) of this section.

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records required to be maintained by this section for the prescribed period, these records shall be transmitted to the director.

(iii) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify the director at least three months prior to the disposal of such records and shall transmit those records to the director if requested within the period.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in WAC 296-62-05215.

(16) **Observation of monitoring.**

(a) Employee observation. The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to lead conducted pursuant to subsection (5) of this section.

(b) Observation procedures.

(i) Whenever observation of the monitoring of employee exposure to lead requires entry into an area where the use of respirators, protective clothing or equipment is required, the employer shall provide the observer with and assure the use of such respirators, clothing and such equipment, and shall require the observer to comply with all other applicable safety and health procedures.

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(ii) Without interfering with the monitoring, observers shall be entitled to:

(A) Receive an explanation of the measurement procedures;

(B) Observe all steps related to the monitoring of lead performed at the place of exposure; and

(C) Record the results obtained or receive copies of the results when returned by the laboratory.

(17) **Appendices.** The information contained in the appendices to this section is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

(a) **Appendix A. Substance Data Sheet for Occupational Exposure to Lead.**

(i) Substance identification.

(A) Substance. Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

(B) Compounds covered by the standard. The word **"lead"** when used in this standard means elemental lead, all inorganic lead compounds (except those which are not biologically available due to either solubility or specific chemical interaction), and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

(C) Uses. Exposure to lead occurs in at least 120 different occupations, including primary and secondary lead smelting, lead storage battery manufacturing, lead pigment manufacturing and use, solder manufacturing and use, shipbuilding and ship repairing, auto manufacturing, and printing.

(D) Permissible exposure. The Permissible Exposure Limit (PEL) set by the standard is 50 micrograms of lead per cubic meter of air (50 $\mu g/m^3$), averaged over an eight-hour work day.

(E) Action level. The standard establishes an action level of 30 micrograms per cubic meter of air (30 $\mu g/m^3$) time weighted average, based on an eight-hour work day. The action level initiates several requirements of the standard, such as exposure monitoring, medical surveillance, and training and education.

(ii) Health hazard data.

(A) Ways in which lead enters your body.

(I) When absorbed into your body in certain doses lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead, but also from the serious toxic effects that may not become apparent until years of exposure have passed.

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(II) Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not absorbed through your skin. When lead is scattered in the air as a dust, fume or mist, it can be inhaled and absorbed through your lungs and upper respiratory tract. Inhalation of airborne lead is generally the most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion.

(III) A significant portion of the lead that you inhale or ingest gets into your blood stream. Once in your blood stream lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in your blood and other tissue. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

(B) Effects of overexposure to lead.

(I) Short-term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from cardiorespiratory arrest. A short-term dose of lead can lead to acute encephalopathy. Short-term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

(II) Long-term (chronic) overexposure.

a) Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic there may be severe abdominal pain.

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b) Damage to the central nervous system in general and the brain (encephalopathy) in particular is one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic "wrist drop" or "foot drop" and is a manifestation of a disease to the nervous system called peripheral neuropathy.

c) Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression of kidney dialysis or death is possible.

d) Chronic overexposure to lead impairs the reproductive systems of both men and women. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility, and abnormal menstrual cycles in women. The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood.

e) Overexposure to lead also disrupts the blood-forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemiais characterized by weakness, pallor and fatigability as a result of decreased oxygen carrying capacity in the blood.

(III) Health protection goals of the standard.

a) Prevention of adverse health effects for most workers from exposure to lead throughout a working lifetime requires that worker blood lead (PbB) levels be maintained at or below forty micrograms per one hundred grams of whole blood (40 µg/100g). The blood lead levels of workers (both male and female workers) who intend to have children should be maintained below 30 µg/100g to minimize adverse reproductive health effects to the parents and to the developing fetus.

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b) The measurement of your blood lead level is the most useful indicator of the amount of lead absorbed by your body. Blood lead levels (PbB) are most often reported in units of milligrams (mg) or micrograms (µg) of lead (1 mg = 1000 µg) per 100 grams (100g), 100 milliters (100 ml) or deciliter (dl) of blood. These three units are essentially the same. Sometimes PbB's are expressed in the form of mg% or µg%. This is a shorthand notation for 100g, 100ml, or dl.

c) PbB measurements show the amount of lead circulating in your blood stream, but do not give any information about the amount of lead stored in your various tissues. PbB measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Past research into lead-related diseases, however, has focused heavily on associations between PbBs and various diseases. As a result, your PbB is an important indicator of the likelihood that you will gradually acquire a lead-related health impairment or disease.

d) Once your blood lead level climbs above 40 µg/100g, your risk of disease increases. There is a wide variability of individual response to lead, thus it is difficult to say that a particular PbB in a given person will cause a particular effect. Studies have associated fatal encephalopathy with PbBs as low as 150 µg/100g. Other studies have shown other forms of disease in some workers with PbBs well below 80 µg/100g. Your PbB is a crucial indicator of the risks to your health, but one other factor is extremely important. This factor is the length of time you have had elevated PbBs. The longer you have an elevated PbB, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage.

e) The best way to prevent all forms of lead-related impairments and diseases--both short-term and long-term--is to maintain your PbB below 40 µg/100g. The provisions of the standard are designed with this end in mind. Your employer has prime responsibility to assure that the provisions of the standard are complied with both by the company and by individual workers.

You as a worker, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own action, and seeing that your employer complies with the provisions governing his actions.

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(IV) Reporting signs and symptoms of health problems. You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead on your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place.

(b) **Appendix B. Employee Standard Summary.** This appendix summarizes key provisions of the standard that you as a worker should become familiar with. The appendix discusses the entire standard.

(i) Permissible exposure limit (PEL). The standard sets a permissible exposure limit (PEL) of fifty micrograms of lead per cubic meter of air (50 $\mu g/m^3$), averaged over and eight-hour workday. This is the highest level of lead in air to which you may be permissibly exposed over an eight-hour workday. Since it is an eight-hour average it permits short exposures above the PEL so long as for each eight-hour workday your average exposure does not exceed the PEL.

(ii) Exposure monitoring.

(A) If lead is present in the work place where you work in any quantity, your employer is required to make an initial determination of whether the action level is exceeded for any employee. The initial determination must include instrument monitoring of the air for the presence of lead and must cover the exposure of a representative number of employees who are reasonably believed to have the highest exposure levels. If your employer has conducted appropriate air sampling for lead in the past year he may use these results. If there have been any employee complaints of symptoms which may be attributable to exposure to lead or if there is any other information or observations which would indicate employee exposure to lead, this must also be considered as part of the initial determination. If this initial determination shows that a reasonable possibility exists that any employee may be exposed, without regard to respirators, over the action level (30 $\mu g/m^3$) your employer must set up an air monitoring program to determine the exposure level of every employee exposed to lead at your work place.

(B) In carrying out this air monitoring program, your employer is not required to monitor the exposure of every employee, but he or she must monitor a representative number of employees and job types. Enough sampling must be done to enable each employee's exposure level to be reasonably represented by at least one full shift (at least seven hours) air sample. In addition, these air samples must be taken under conditions which represent each employee's regular, daily exposure to lead.

(C) If you are exposed to lead and air sampling is performed, your employer is required to quickly notify you in writing of air monitoring results which represent your exposure. If the results indicate your exposure exceeds the PEL (without regard to your use of respirators), then your employer must also notify you of this in writing, and provide you with a description of the corrective action that will be taken to reduce your exposure.

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(D) Your exposure must be rechecked by monitoring every six months if your exposure is over the action level but below the PEL. Air monitoring must be repeated every three months if you are exposed over the PEL. Your employer may discontinue monitoring for you if two consecutive measurements, taken at least two weeks apart, are below the action level. However, whenever there is a production, process, control, or personnel change at your work place which may result in new or additional exposure to lead, or whenever there is any other reason to suspect a change which may result in new or additional exposure to lead, your employer must perform additional monitoring.

(iii) Methods of compliance. Your employer is required to assure that no employee is exposed to lead in excess of the PEL. The standard establishes a priority of methods to be used to meet the PEL.

(iv) Respiratory protection.

(A) Your employer is required to provide and assure your use of respirators when your exposure to lead is not controlled below the PEL by other means. The employer must pay the cost of the respirator. Whenever you request one, your employer is also required to provide you a respirator even if your air exposure level does not exceed the PEL. You might desire a respirator when, for example, you have received medical advice that your lead absorption should be decreased. Or, you may intend to have children in the near future, and want to reduce the level of lead in your body to minimize adverse reproductive effects. While respirators are the least satisfactory means of controlling your exposure, they are capable of providing significant protection if properly chosen, fitted, worn, cleaned, maintained, and replaced when they stop providing adequate protection.

(B) Your employer is required to select respirators from the seven types listed in Table II of the respiratory protection section of this standard (see subsection (7)(c) of this section). Any respirator chosen must be certified by the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 42 CFR part 84. This respirator selection table will enable your employer to choose a type of respirator which will give you a proper amount of protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than is present in your work place. For example, a powered air purifying respirator (PAPR) is much more protective than a typical negative-pressure respirator, and may also be more comfortable to wear. A PAPR has a filter, cartridge or canister to clean the air, and a power source which continuously blows filtered air into your breathing zone. Your employer might make a PAPR available to you to ease the burden of having to wear a respirator for long periods of time. The standard provides that you can obtain a PAPR upon request.

(C) Your employer must also start a respiratory protection program. This program must include written procedures for the proper selection, use, cleaning, storage, and maintenance of respirators.

(D) Your employer must assure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical to your protection against air borne lead. Obtaining a proper fit on each employee may require your employer to make

available several different types of respirator masks. To ensure that your respirator fits properly and that facepiece leakage is minimal, your employer must give you either a qualitative or quantitative fit test as required in chapter 296-62 WAC, Part E.

(E) You must also receive from your employer proper training in the use of respirators. Your employer is required to teach you how to wear a respirator, to know why it is needed, and to understand its limitations.

(F) The standard provides that if your respirator uses filter elements, you must be given an opportunity to change the filter elements whenever an increase in breathing resistance is detected. You also must be permitted to periodically leave your work area to wash your face and respirator facepiece whenever necessary to prevent skin irritation. If you ever have difficulty breathing during a fit test or while using a respirator, your employer must make a medical examination available to you to determine whether you can safely wear a respirator. The result of this examination may be to give you a positive pressure respirator (which reduces breathing resistance) or to provide alternative means of protection.

(v) Protective work clothing and equipment. If you are exposed to lead above the PEL, or if you are exposed to lead compounds such as lead arsenate or lead azide which can cause skin and eye irritation, your employer must provide you with protective work clothing and equipment appropriate for the hazard. If work clothing is provided, it must be provided in a clean and dry condition at least weekly, and daily if your airborne exposure to lead is greater than 200 $\mu g/m^3$. Appropriate protective work clothing and equipment can include coveralls or similar full-body work clothing, gloves, hats, shoes or disposable shoe coverlets, and face shields or vented goggles. Your employer is required to provide all such equipment at no cost to you. He or she is responsible for providing repairs and replacement as necessary and also is responsible for the cleaning, laundering or disposal of protective clothing and equipment. Contaminated work clothing or equipment must be removed in change rooms and not worn home or you will extend your exposure and expose your family since lead from your clothing can accumulate in your house, car, etc. Contaminated clothing which is to be cleaned, laundered or disposed of must be placed in closed containers in the change room. At no time may lead be removed from protective clothing or equipment by any means which disperses lead into the work room air.

(vi) Housekeeping. Your employer must establish a housekeeping program sufficient to maintain all surfaces as free as practicable of accumulations of lead dust. Vacuuming is the preferred method of meeting this requirement, and the use of compressed air to clean floors and other surfaces is absolutely prohibited. Dry or wet sweeping, shoveling, or brushing may not be used except where vacuuming or other equally effective methods have been tried and do not work. Vacuums must be used and emptied in a manner which minimizes the reentry of lead into the work place.

(vii) Hygiene facilities and practices.

(A) The standard requires that change rooms, showers and filtered air lunchrooms be constructed and made available to workers exposed to lead above the PEL. When the PEL is exceeded, the employer must assure that food and beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, except in these facilities. Change rooms, showers and lunchrooms, must be used by workers exposed in excess of the PEL. After

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showering no clothing or equipment worn during the shift may be worn home and this includes shoes and underwear. Your own clothing worn during the shift should be carried home and cleaned carefully so that it does not contaminate your home. Lunchrooms may not be entered with protective clothing or equipment unless surface dust has been removed by vacuuming, downdraft booth or other cleaning methods. Finally, workers exposed above the PEL must wash both their hands and faces prior to eating, drinking, smoking or applying cosmetics.

(B) All of the facilities and hygiene practices just discussed are essential to minimize additional sources of lead absorption from inhalation or ingestion of lead that may accumulate on you, your clothes or your possessions. Strict compliance with these provisions can virtually eliminate several sources of lead exposure which significantly contribute to excessive lead absorption.

(viii) Medical surveillance.

(A) The medical surveillance program is part of the standard's comprehensive approach to the prevention of lead-related disease. Its purpose is to supplement the main thrust of the standard which is aimed at minimizing airborne concentrations of lead and sources of ingestion. Only medical surveillance can determine if the other provisions of the standard have effectively protected you as an individual. Compliance with the standard's provision will protect most workers from the adverse effects of lead exposure, but may not be satisfactory to protect individual workers (I) who have high body burdens of lead acquired over past years, (II) who have additional uncontrolled sources of nonoccupational lead exposure, (III) who exhibit unusual variations in lead absorption rates, or (IV) who have specific nonwork related medical conditions which could be aggravated by lead exposure (e.g., renal disease, anemia). In addition, control systems may fail, or hygiene and respirator programs may be inadequate. Periodic medical surveillance of individual workers will help detect those failures. Medical surveillance will also be important to protect your reproductive ability - regardless of whether you are a man or a woman.

(B) All medical surveillance required by the standard must be performed by or under the supervision of a licensed physician. The employer must provide required medical surveillance without cost to employees and at a reasonable time and place. The standard's medical surveillance program has two parts - periodic biological monitoring, and medical examinations.

(C) Your employer's obligation to offer medical surveillance is triggered by the results of the air monitoring program. Medical surveillance must be made available to all employees who are exposed in excess of the action level for more than 30 days a year. The initial phase of the medical surveillance program, which included blood lead level tests and medical examinations, must be completed for all covered employees no later than 180 days from the effective date of this standard. Priority within this first round of medical surveillance must be given to employees whom the employer believes to be at greatest risk from continued exposure (for example, those with the longest prior exposure to lead, or those with the highest current exposure). Thereafter, the employer must periodically make medical surveillance - both biological monitoring and medical examinations - available to all covered employees.

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(D) Biological monitoring under the standard consists of blood lead level (PbB) and zinc protoporphyrin tests at least every six months after the initial PbB test. A zinc protoporphyrin (ZPP) test is a very useful blood test which measures an effect of lead on your body. If a worker's PbB exceeds 40 µg/100g, the monitoring frequency must be increased from every six months to at least every two months and not reduced until two consecutive PbBs indicate a blood lead level below 40 µg/100g. Each time your PbB is determined to be over 40µg/100g, your employer must notify you of this in writing within five working days of the receipt of the test results. The employer must also inform you that the standard requires temporary medical removal with economic protection when your PbB exceeds certain criteria (see Discussion of Medical Removal Protection - subsection (12)). During the first year of the standard, this removal criterion is 80 µg/100g. Anytime your PbB exceeds 80 µg/100g your employer must make available to you a prompt follow-up PbB test to ascertain your PbB. If the two tests both exceed 80 µg/100g and you are temporarily removed, then your employer must make successive PbB tests available to you on a monthly basis during the period of your removal.

(E) Medical examinations beyond the initial one must be made available on an annual basis if your blood lead levels exceeds 40 µg/100g at any time during the preceding year. The initial examination will provide information to establish a baseline to which subsequent data can be compared. An initial medical examination must also be made available (prior to assignment) for each employee being assigned for the first time to an area where the airborne concentration of lead equals or exceeds the action level. In addition, a medical examination or consultation must be made available as soon as possible if you notify your employer that you are experiencing signs or symptoms commonly associated with lead poisoning or that you have difficulty breathing while wearing a respirator or during a respirator fit test. You must also be provided a medical examination or consultation if you notify your employer that you desire medical advice concerning the effects of current or past exposure to lead on your ability to procreate a healthy child.

(F) Finally, appropriate follow-up medical examinations or consultations may also be provided for employees who have been temporarily removed from exposure under the medical removal protection provisions of the standard (see item (ix) below).

(G) The standard specifies the minimum content of preassignment and annual medical examinations. The content of other types of medical examinations and consultations is left up to the sound discretion of the examining physician. Preassignment and annual medical examinations must include (I) a detailed work history and medical history, (II) a thorough physical examination, and (III) a series of laboratory tests designed to check your blood chemistry and your kidney function. In addition, at any time upon your request, a laboratory evaluation of male fertility will be made (microscopic examination of a sperm sample), or a pregnancy test will be given.

(H) The standard does not require that you participate in any of the medical procedures, tests, etc., which your employer is required to make available to you. Medical surveillance can, however, play a very important role in protecting your health.

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You are strongly encouraged, therefore, to participate in a meaningful fashion. Generally, your employer will choose the physician who conducts medical surveillance under the lead standard - unless you and your employer can agree on the choice of a physician or physicians. Some companies and unions have agreed in advance, for example, to use certain independent medical laboratories or panels of physicians. Any of these arrangements are acceptable so long as required medical surveillance is made available to workers.

(I) The standard requires your employer to provide certain information to a physician to aid in his or her examination of you. This information includes (I) the standard and its appendices, (II) a description of your duties as they relate to lead exposure, (III) your exposure level, (IV) a description of personal protective equipment you wear, (V) prior blood level results, and (VI) prior written medical opinions concerning you that the employer has.

After a medical examination or consultation the physician must prepare a written report which must contain (I) the physician's opinion as to whether you have any medical conditions which places you at increased risk of material impairment to health from exposure to lead, (II) any recommended special protective measures to be provided to you, (III) any blood lead level determinations, and (IV) any recommended limitation on your use of respirators. This last element must include a determination of whether you can wear a powered air purifying respirator (PAPR) if you are found unable to wear a negative pressure respirator.

(J) The medical surveillance program of the lead standard may at some point in time serve to notify certain workers that they have acquired a disease or other adverse medical condition as a result of occupational lead exposure. If this is true these workers might have legal rights to compensation from public agencies, their employers, firms that supply hazardous products to their employers, or other persons. Some states have laws, including worker compensation laws, that disallow a worker to learn of a job-related health impairment to sue, unless the worker sues within a short period of time after learning of the impairment. (This period of time may be a matter of months or years.) An attorney can be consulted about these possibilities. It should be stressed that WISHA is in no way trying to either encourage or discourage claims or lawsuits. However, since results of the standard's medical surveillance program can significantly affect the legal remedies of a worker who has acquired a job-related disease or impairment, it is proper for WISHA to make you aware of this.

(K) The medical surveillance section of the standard also contains provisions dealing with chelation. Chelation is the use of certain drugs (administered in pill form or injected into the body) to reduce the amount of lead absorbed in body tissues. Experience accumulated by the medical and scientific communities has largely confirmed the effectiveness of this type of therapy for the treatment of very severe lead poisoning. On the other hand it has also been established that there can be a long list of extremely harmful side effects associated with the use of chelating agents. The medical community has balanced the advantages and disadvantages resulting from the use of chelating agents in various circumstances and has established when the use of these agents is acceptable. The standard includes these accepted limitations due to a history of abuse of chelation therapy by some lead companies. The most widely used chelating agents are calcium disodium EDTA, (Ca Na2EDTA), Calcium

Disodium Versenate (Versenate), and d-penicillamine (penicillamine or Cupramine).

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(L) The standard prohibits "prophylactic chelation" of any employee by any person the employer retains, supervises or controls. "Prophylactic chelation" is the routine use of chelating or similarly acting drugs to prevent elevated blood levels in workers who are occupationally exposed to lead, or the use of these drugs to routinely lower blood lead levels to predesignated concentrations believed to be safe. It should be emphasized that where an employer takes a worker who has no symptoms of lead poisoning and has chelation carried out by a physician (either inside or outside of a hospital) solely to reduce the worker's blood lead level, that will generally be considered prophylactic chelation. The use of a hospital and a physician does not mean that prophylactic chelation is not being performed. Routine chelation to prevent increased or reduce current blood lead levels is unacceptable whatever the setting.

(M) The standard allows the use of "therapeutic" or "diagnostic" chelation if administered under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring. Therapeutic chelation responds to severe lead poisoning where there are marked symptoms. Diagnostic chelation, involves giving a patient a dose of the drug then collecting all urine excreted for some period of time as an aid to the diagnosis of lead poisoning.

(N) In cases where the examining physician determines that chelation is appropriate, you must be notified in writing of this fact before such treatment. This will inform you of a potentially harmful treatment, and allow you to obtain a second opinion.

(ix) Medical removal protection.

(A) Excessive lead absorption subjects you to increased risk of disease. Medical removal protection (MRP) is a means of protecting you when for whatever reasons, other methods, such as engineering controls, work practices, and respirators, have failed to provide the protection you need. MRP involves the temporary removal of a worker from his or her regular job to a place of significantly lower exposure without any loss of earnings, seniority, or other employment rights of benefits. The purpose of this program is to cease further lead absorption and allow your body to naturally excrete lead which has previously been absorbed. Temporary medical removal can result from an elevated blood lead level, or a medical opinion. Up to eighteen months of protection is provided as a result of either form of removal. The vast majority of removed workers, however, will return to their former jobs long before this eighteen month period expires. The standard contains special provisions to deal with the extraordinary but possible case where a long-term worker's blood lead level does not adequately decline during eighteen months of removal.

(B) During the first year of the standard, if your blood lead level is 80 µg/100g or above you must be removed from any exposure where your air lead level without a respirator would be 100 $\mu g/m^3$ or above. If you are removed from your normal job you may not be returned until your blood lead level declines to at least 60 µg/100g. These criteria for removal and return will change according to the following schedule:

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TABLE 1

Effective Date	Removal Blood Level (µg/100g)	Air Lead ($\mu g/m^3$)	Return Blood Lead ($\mu g/m^3$)
09/06/81	At or above 70	50 or above	At or below 50
09/06/82	At or above 60	30 or above	At or below 40
09/06/84	At or above 50 averaged over six months	30 or above	At or below 40

(C) You may also be removed from exposure even if your blood lead levels are below these criteria if a final medical determination indicates that you temporarily need reduced lead exposure for medical reasons. If the physician who is implementing your employers medical program makes a final written opinion recommending your removal or other special protective measures, your employer must implement the physician's recommendation. If you are removed in this manner, you may only be returned when the physician indicates it is safe for you to do so.

(D) The standard does not give specific instructions dealing with what an employer must do with a removed worker. Your job assignment upon removal is a matter for you, your employer and your union (if any) to work out consistent with existing procedures for job assignments. Each removal must be accomplished in a manner consistent with existing collective bargaining relationships. Your employer is given broad discretion to implement temporary removals so long as no attempt is made to override existing agreements. Similarly, a removed worker is provided no right to veto an employer's choice which satisfies the standard.

(E) In most cases, employers will likely transfer removed employees to other jobs with sufficiently low lead exposure. Alternatively, a worker's hours may be reduced so that the time weighted average exposure is reduced, or he or she may be temporarily laid off if no other alternative is feasible.

(F) In all of these situations, MRP benefits must be provided during the period of removal - i.e., you continue to receive the same earnings, seniority, and other rights and benefits you would have had if you had not been removed. Earnings include more that just your base wage; it includes overtime, shift differentials, incentives, and other compensation you would have earned if you had not been removed.

During the period of removal you must also be provided with appropriate follow-up medical surveillance. If you were removed because your blood lead level was too high, you must be provided with a monthly blood test. If a medical opinion caused your removal, you must be provided medical tests or examinations that the physician believes to be appropriate. If you do not participate in this follow-up medical surveillance, you may lose your eligibility for MRP benefits.

(G) When you are medically eligible to return to your former job, your employer must return you to your “former job status.” This means that you are entitled to the position, wages, benefits, etc., you would have had if you had not been removed. If you would still be in your old job if no removal had occurred, that

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is where you go back. If not, you are returned consistent with whatever job assignment discretion your employer would have had if no removal had occurred. MRP only seeks to maintain your rights, not expand them or diminish them.

(H) If you are removed under MRP and you are also eligible for worker compensation or other compensation for lost wages, your employer's MRP benefits obligation is reduced by the amount that you actually receive from these other sources. This is also true if you obtain other employment during the time you are laid off with MRP benefits.

(I) The standard also covers situations where an employer voluntarily removes a worker from exposure to lead due to the effects of lead on the employee's medical condition, even though the standard does not require removal. In these situations MRP benefits must still be provided as though the standard required removal. Finally, it is important to note that in all cases where removal is required, respirators cannot be used as a substitute. Respirators may be used before removal becomes necessary, but not as an alternative to a transfer to a low exposure job, or to a lay-off with MRP benefits.

(x) Employee information and training.

(A) Your employer is required to provide an information and training program for all employees exposed to lead above the action level or who may suffer skin or eye irritation from lead. This program must inform these employees of the specific hazards associated with their work environment, protective measures which can be taken, the danger of lead to their bodies (including their reproductive systems), and their rights under the standard. In addition, your employer must make readily available to all employees, included those exposed below the action level, a copy of the standard and its appendices and must distribute to all employees any materials provided to the employer under the Washington Industrial Safety and Health Act (WISHA).

(B) Your employer is required to complete this training for all employees by March 4, 1981. After this date, all new employees must be trained prior to initial assignment to areas where there is possibility of exposure over the action level. This training program must also be provided at least annually thereafter.

(xi) Signs. The standard requires that the following warning sign be posted in work areas where the exposure to lead exceeds the PEL:

WARNING
LEAD WORK AREA
NO SMOKING OR EATING

(xii) Recordkeeping.

(A) Your employer is required to keep all records of exposure monitoring for airborne lead. These records must include the name and job classification of employees measured, details of the sampling and analytic techniques, the results of this sampling and the type of respiratory protection being worn by the person sampled. Your employer is also required to keep all records of biological monitoring and medical examination results. These must include the names of the employees, the physician's written opinion and a copy of the results of the

examination. All of the above kinds of records must be kept for 40 years, or for at least 20 years after your termination of employment, whichever is longer.

(B) Recordkeeping is also required if you are temporarily removed from your job under the MRP program. This record must include your name and social security number, the date of your removal and return, how the removal was or is being accomplished, and whether or not the reason for the removal was an elevated blood lead level. Your employer is required to keep each medical removal record only for as long as the duration of an employee's employment.

(C) The standard requires that if you request to see or copy environmental monitoring, blood lead level monitoring, or medical removal records, they must be made available to you or to a representative that you authorize. Your union also has access to these records. Medical records other than PbBs must also be provided to you upon request, to your physician or to any other person whom you may specifically designate. Your union does not have access to your personal medical records unless you authorize their access.

(xiii) Observations of monitoring. When air monitoring for lead is performed at your work place as required by this standard, your employer must allow you or someone you designate to act as an observer of the monitoring. Observers are entitled to an explanation of the measurement procedure, and to record the results obtained. Since results will not normally be available at the time of the monitoring, observers are entitled to record or receive the results of the monitoring when returned by the laboratory. Your employer is required to provide the observer with any personal protective devices required to be worn by employees working in the areas that is being monitored. The employer must require the observer to wear all such equipment and to comply with all other applicable safety and health procedures.

(xiv) Effective date. The standard's effective date is September 6, 1980, and the employer's obligation under the standard begin to come into effect as of that date. The standard was originally adopted as WAC 296-62-07349 and later recodified to WAC 296-62-07521.

(c) **Appendix C. Medical Surveillance Guidelines.**

(i) Introduction.

(A) The primary purpose of the Washington Industrial Safety and Health Act of 1973 is to assure, so far as possible, safe and healthful working conditions for every working man and woman. The occupational health standard for inorganic lead* was promulgated to protect workers exposed to inorganic lead including metallic lead, all inorganic lead compounds and organic lead soaps.

*The term inorganic lead used throughout the medical surveillance appendices is meant to be synonymous with the definition of lead set forth in the standard.

(B) Under this final standard in effect as of September 6, 1980, occupational exposure to inorganic lead is to be limited to 50 $\mu g/m^3$ (micrograms per cubic meter) based on an eight-hour time-weighted average (TWA). This level of exposure eventually must be achieved through a combination of engineering, work practice and other administrative controls. Periods of time ranging from one to ten years are provided for different industries to implement these controls which are based on individual industry considerations. Until these controls are in place, respirators must be used to meet the 50 $\mu g/m^3$ exposure limit.

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(C) The standard also provides for a program of biological monitoring and medical surveillance for all employees exposed to levels of inorganic lead above the action level of 30 µg/m^3 for more than thirty days per year.

(D) The purpose of this document is to outline the medical surveillance provisions of the standard for inorganic lead, and to provide further information to the physician regarding the examination and evaluation of workers exposed to inorganic lead.

(E) Item (ii) provides a detailed description of the monitoring procedure including the required frequency of blood testing for exposed workers, provisions for medical removal protection (MRP), the recommended right of the employee to a second medical opinion, and notification and recordkeeping requirements of the employer.

A discussion of the requirements for respirator use and respirator monitoring and WISHA's position on prophylactic chelation therapy are also included in this section.

(F) Item (iii) discusses the toxic effects and clinical manifestations of lead poisoning and effects of lead intoxication on enzymatic pathways in heme synthesis. The adverse effects on both male and female reproductive capacity and on the fetus are also discussed.

(G) Item (iv) outlines the recommended medical evaluation of the worker exposed to inorganic lead including details of the medical history, physical examination, and recommended laboratory tests, which are based on the toxic effects of lead as discussed in item (ii).

(H) Item (v) provides detailed information concerning the laboratory tests available for the monitoring of exposed workers. Included also is a discussion of the relative value of each test and the limitations and precautions which are necessary in the interpretation of the laboratory results.

(I) Airborne levels to be achieved without reliance or respirator protection through a combination of engineering and work practice or other administrative controls are illustrated in the following table:

Industry	**Permissible Lead Level/Compliance Date**		
	200µg/m^3	**100µg/m^3**	**50µg/m^3**
Primary Lead Production.	1973	06/29/84	06/29/91
Secondary Lead Production.	1973	06/29/84	06/29/91
Lead Acid Battery Manufacturing.	1973	06/29/83	06/29/91
Automobile Mfg,/ Solder, Grinding.	1973	N/A	03/08/97
Electronics, Gray Iron Foundries, Ink Mfg., Paints and Coatings Mfg., Can Mfg., Wallpaper Mfg., and Printing.	1973	N/A	06/29/91

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Lead chemical Mfg., Nonferrous Foundries, Leaded Steel Mfg., Battery Breaking in the Collection and Processing of Scrap (when not a part of secondary lead smelter), Secondary Copper Smelter, Brass and Bronze Ingot Production.	1973	N/A	N/A[1]*
All Other Industries.	1973	N/A	09/08/92

* Feasibility of achieving the PEL by engineering and work practice controls for these industries has yet to be resolved in court, therefore no date has been scheduled.

(ii) Medical surveillance and monitoring requirements for workers exposed to inorganic lead.

(A) Under the occupational health standard for inorganic lead, a program of biological monitoring and medical surveillance is to be made available to all employees exposed to lead above the action level of 30 µg/m^3 TWA for more than thirty days each year. This program consists of periodic blood sampling and medical evaluation to be performed on a schedule which is defined by previous laboratory results, worker complaints or concerns, and the clinical assessment of the examining physician.

(B) Under this program, the blood lead level of all employees who are exposed to lead above the action level of 30 µg/m^3 is to be determined at least every six months. The frequency is increased to every two months for employees whose last blood lead level was between 40µg/100g whole blood and the level requiring employee medical removal to be discussed below. For employees who are removed from exposure to lead due to an elevated blood lead, a new blood lead level must be measured monthly. Zinc protoporphyrin (ZPP) measurement is required on each occasion that a blood lead level measurement is made.

(C) An annual medical examination and consultation performed under the guidelines discussed in item (iv) is to be made available to each employee for whom a blood test conducted at any time during the preceding twelve months indicated a blood lead level at or above 40µg/100g. Also, an examination is to be given to all employees prior to their assignment to an area in which airborne lead concentrations reach or exceed the action level. In addition, a medical examination must be provided as soon as possible after notification by an employee that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice regarding lead exposure and the ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during respirator use. An examination is also to be made available to each employee removed from exposure to lead due to a risk of sustaining material impairment to health, or otherwise limited or specially protected pursuant to medical recommendations.

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(D) Results of biological monitoring or the recommendations of an examining physician may necessitate removal of an employee from further lead exposure pursuant to the standard's medical removal program (MRP). The object of the MRP program is to provide temporary medical removals to workers either with substantially elevated blood lead levels or otherwise at risk of sustaining material health impairment from continued substantial exposure to lead. The following guidelines which are summarized in Table 10 were created under the standard for the temporary removal of an exposed employee and his or her subsequent return to work in an exposure area.

TABLE 10
EFFECTIVE DATE

	Sept. 6, 1980	**Sept. 6, 1981**	**Sept. 6, 1982**	**Sept. 6, 1983**	**Sept. 6, 1984**
A. Blood lead level requiring employee medical removal (level must be confirmed with second follow-up blood lead level within two weeks of first report).	>80 µg/100g.	>70 µg/100g.	>60 µg/100g.	>60 µg/100g.	>60 µg/100g or average of last three blood samples or all blood samples over previous 6 months (whichever is over a longer time period) is 50 µg/100g or greater unless last sample is 40 µg/100g or less.
B. Frequency which employees exposed is action level of lead (30 $\mu g/m^8$ TWA) must have blood lead level checked. (ZPP is also required in each occasion that a blood test is obtained):					
1. Last blood lead level less than 40 µg/100g.	Every 6 months	Every 6 months.	Every 6 months.	Every 6 months.	Every 6 months.

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2. Last blood lead level between 40 µg/100g and level requiring medical removal (see A above).	Every 2 months.	Every 2 months.	Every 2 months.	Every two months.	Every 2 months.
3. Employees removed from exposure to lead because of an elevated blood lead level.	Every 1 month.	Every 1 month.	Every 1 month.	Every 1 month.	Every 1 month.
C. Permissible airborne exposure limit for workers removed from work due to an elevated blood lead level (without regard to respirator protection.	100 µg/m^3 8 hr TWA	50 µg/m^3 8 hr TWA	30 µg/m^3 8 hr TWA	30 µg/m^3 8 hr TWA	30 µg/m^3 8 hr TWA
D. Blood lead level confirmed with a second blood analysis, at which employee may return to work. Permissible exposure without regard to respirator protection is listed by industry in Table 1	60 µg/100g	50 µg/100g	40 µg/100g	40 µg/100g	40 µg/100g

Note: Where medical opinion indicates that an employee is at risk of material impairment from exposure to lead, the physician can remove an employee from exposure exceeding the action level (or less) or recommend special protective measures as deemed appropriate and necessary. Medical monitoring during the medical removal period can be more stringent than noted in the table above if the physician so specifies. Return to work or removal of limitations and special protections is permitted when the physician indicates that the worker is no longer at risk of material impairment.

(E) Under the standard's ultimate worker removal criteria, a worker is to be removed from any work having any eight-hour TWA exposure to lead of 30 µg/m^3or more whenever either of the following circumstances apply. (I) a blood lead level of 60 µg/100g or greater is obtained and confirmed by a second follow-up blood lead level performed within two weeks after the employer receives the results of the first blood sample test, or (II) the average of the previous three blood lead determinations or the average of all blood lead determinations conducted during the previous six months, whichever encompasses the longest time period, equals or exceeds 50 µg/100g, unless the last blood sample indicates a blood lead level at or below 40 µg/100g, in which case the employee need not be removed. Medical removal is to continue until two consecutive blood lead levels are 40 µg/100g or less.

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(F) During the first two years that the ultimate removal criteria are being phased in, the return criteria have been set to assure that a worker's blood lead level has substantially declined during the period of removal. From March 1, 1979, to March 1, 1980, the blood lead level requiring employee medial removal is 80 µg/100g. Workers found to have a confirmed blood lead at this level or greater need only be removed from work having a daily eight hour TWA exposure to lead at or above 100 $\mu g/m^3$. Workers so removed are to be returned to work when their blood lead levels are at or below 60 µg/100g of whole blood. From March 1, 1980, to March 1, 1981, the blood lead level requiring medical removal is 70 µg/100g. During this period workers need only be removed from jobs having a daily eight hour TWA exposure to lead at or above 50 $\mu g/m^3$ and are to be returned to work when a level of 50 µg/100g is achieved. Beginning March 1, 1981, return depends on the worker's blood lead level declining to 40 µg/100g of whole blood.

(G) As part of the standard, the employer is required to notify in writing each employee whose whole blood lead level exceeds 40 µg/100g. In addition, each such employee is to be informed that the standard requires medical removal with MRP benefits, discussed below, when an employee's blood lead level exceeds the above defined limits.

(H) In addition to the above blood lead level criteria, temporary worker removal may also take place as a result of medical determinations and recommendations. Written medical opinions must be prepared after each examination pursuant to the standard. If the examining physician includes medical finding, determination or opinion that the employee has a medical condition which places the employee at increased risk of material health impairment from exposure to lead, then the employee must be removed from exposure to lead at or above the action level. Alternatively, if the examining physician recommends special protective measures for an employee (e.g., use of a powered air purifying respirator) or recommends limitations on an employee's exposure to lead, then the employer must implement these recommendations. Recommendations may be more stringent than the specific provisions of the standard. The examining physician, therefore, is given broad flexibility to tailor special protective procedures to the needs of individual employees. This flexibility extends to the evaluation and management of pregnant workers and male and female workers who are planning to conceive children. Based on the history, physical examination, and laboratory studies, the physician might recommend special protective measures or medical removal for an employee who is pregnant or who is planning to conceive a child when, in the physician's judgment, continued exposure to lead at the current job would pose a significant risk. The return of the employee to his or her former job status, or the removal of special protections or limitations, depends upon the examining physician determining that the employee is no longer at increased risk of material impairment or that the special measures are no longer needed.

(I) During the period of any form of special protection or removal, the employer must maintain the worker's earnings, seniority, and other employment rights and benefits (as though the worker has not been removed) for a period of up to eighteen months. This economic protection will maximize meaningful worker participation in the medical surveillance program, and is appropriate as part of

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the employer's overall obligation to provide a safe and healthful work place. The provisions of MRP benefits during the employee's removal period may, however, be conditioned upon participation in medical surveillance.

(J) On rare occasions, an employee's blood lead level may not acceptably decline within eighteen months of removal. This situation will arise only in unusual circumstances, thus the standard relies on an individual medical examination to determine how to protect such an employee. This medical determination is to be based on both laboratory values, including lead levels, zinc protoporphyrin levels, blood counts, and other tests felt to be warranted, as well as the physician's judgment that any symptoms or findings on physical examination are a result of lead toxicity. The medical determination may be that the employee is incapable of ever safely returning to his or her former job status. The medical determination may provide additional removal time past eighteen months for some employees or specify special protective measures to be implemented.

(K) The lead standard provides for a multiple physician review in cases where the employee wishes a second opinion concerning potential lead poisoning or toxicity. If an employee wishes a second opinion, he or she can make an appointment with a physician of his or her choice. This second physician will review the findings, recommendations or determinations of the first physician and conduct any examinations, consultations or tests deemed necessary in an attempt to make a final medical determination. If the first and second physicians do not agree in their assessment they must try to resolve their differences. If they cannot reach an agreement then they must designate a third physician to resolve the dispute.

(L) The employer must provide examining and consulting physicians with the following specific information: A copy of the lead regulations and all appendices, a description of the employee's duties as related to exposure, the exposure level to lead and any other toxic substances (if applicable), a description of personal protective equipment used, blood lead levels, and all prior written medical opinions regarding the employee in the employer's possession or control. The employer must also obtain from the physician and provide the employee with a written medical opinion containing blood lead levels, the physician's opinion as to whether the employee is at risk of material impairment to health, any recommended protective measures for the employee if further exposure is permitted, as well as any recommended limitations upon an employee's use of respirators.

(M) Employers must instruct each physician not to reveal to the employer in writing or in any other way his or her findings, laboratory results, or diagnoses which are felt to be unrelated to occupational lead exposure. They must also instruct each physician to advise the employee of any occupationally or nonoccupationally related medical condition requiring further treatment or evaluation.

(N) The standard provides for the use of respirators when engineering and other primary controls have not been fully implemented. However, the use of respirator protection shall not be used in lieu of temporary medical removal due to elevated blood lead levels or findings that an employee is at risk of material health impairment. This is based on the numerous inadequacies of respirators including skin rash where the facepiece makes contact with the skin,

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unacceptable stress to breathing in some workers with underlying cardiopulmonary impairment, difficulty in providing adequate fit, the tendency for respirators to create additional hazards by interfering with vision, hearing, and mobility, and the difficulties of assuring the maximum effectiveness of a complicated work practice program involving respirators. Respirators do, however, serve a useful function where engineering and work practice are inadequate by providing interim or short-term protection, provided they are properly selected for the environment in which the employee will be working, properly fitted to the employee, maintained and cleaned periodically, and worn by the employee when required.

(O) In its final standard on occupational exposure to inorganic lead, WISHA has prohibited prophylactic chelation. Diagnostic and therapeutic chelation are permitted only under the supervision of a licensed physician with appropriate medical monitoring in an acceptable clinical setting. The decision to initiate chelation therapy must be made on an individual basis and take into account the severity of symptoms felt to be a result of lead toxicity along with blood lead levels, ZPP levels and other laboratory tests as appropriate. EDTA and penicillamine, which are the primary chelating agents used in the therapy of occupational lead poisoning, have significant potential side effects and their use must be justified on the basis of expected benefits to the worker.

(P) Unless frank and severe symptoms are present, therapeutic chelation is not recommended given the opportunity to remove a worker from exposure and allow the body to naturally excrete accumulated lead. As a diagnostic aid, the chelation mobilization test using CA-EDTA has limited applicability. According to some investigators, the tests can differentiate between lead-induced and other nephropathies. The test may also provide an estimation of the mobile fraction of the total body lead burden.

(Q) Employers are required to assure that accurate records are maintained on exposure monitoring, medical surveillance, and medical removal for each employee. Exposure monitoring and medical surveillance records must be kept for forty years or the duration of employment plus twenty years, whichever is longer, while medical removal records must be maintained for the duration of employment. All records required under the standard must be made available upon request to representatives of the director of the department of labor and industries. Employers must also make environmental and biological monitoring and medical removal records available to affected employees and to former employees or their authorized employee representatives. Employees or their specifically designated representatives have access to their entire medical surveillance records.

(R) In addition, the standard requires that the employer inform all workers exposed to lead at or above the action level of the provisions of the standard and all its appendices, the purpose and description of medical surveillance and provisions for medical removal protection if temporary removal is required. An understanding of the potential health effects of lead exposure by all exposed employees along with full understanding of their rights under the lead standard is essential for an effective monitoring program.

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(iii) Adverse health effects of inorganic lead.

(A) Although the toxicity of lead has been known for 2,000 years, the knowledge of the complex relationship between lead exposure and human response is still being refined. Significant research into the toxic properties of lead continues throughout the world, and it should be anticipated that our understanding of thresholds of effects and margins of safety will be improved in future years. The provisions of the lead standard are founded on two prime medical judgments; first, the prevention of adverse health effects from exposure to lead throughout a working lifetime requires that worker blood lead levels be maintained at or below 40 µg/100g, and second, the blood lead levels of workers, male or female, who intend to parent in the near future should be maintained below 30 µg/100g to minimize adverse reproduction health effects to the parent and developing fetus. The adverse effects of lead on reproduction are being actively researched and WISHA encourages the physician to remain abreast of recent developments in the area to best advise pregnant workers or workers planning to conceive children.

(B) The spectrum of health effects caused by lead exposure can be sub-divided into five developmental states; normal, physiological changes of uncertain significance, pathophysiological changes, overt symptoms (morbidity), and mortality. Within this process there are no sharp distinctions, but rather a continuum of effects. Boundaries between categories overlap due to the wide variation of individual responses and exposures in the working population. WISHA's development of the lead standard focused on pathophysiological changes as well as later stages of disease.

(I) Heme synthesis inhibition.

a) The earliest demonstrated effect of lead involves its ability to inhibit at least two enzymes of the heme synthesis pathway at very low blood levels. Inhibition of delta aminolevulinic acid dehydrase (ALA-D) which catalyzes the conversion of delta-aminolevulinic acid (ALA) to protoporphyrin is observed at a blood lead level below 20µg/100g whole blood. At a blood lead level of 40 µg/100g, more than twenty percent of the population would have seventy percent inhibition of ALA-D. There is an exponential increase in ALA excretion at blood lead levels greater than 40 µg/100g.

b) Another enzyme, ferrochelatase, is also inhibited at low blood lead levels. Inhibition of ferrochelatase leads to increased free erythrocyte protoporphyrin (FEP) in the blood which can then bind to zinc to yield zinc protoporphyrin. At a blood lead level of 50µg/100g or greater, nearly 100 percent of the population will have an increase FEP. There is also an exponential relationship between blood lead levels greater than 40 µg/100g and the associated ZPP level, which has led to the development of the ZPP screening test for lead exposure.

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c) While the significance of these effects is subject to debate, it is WISHA's position that these enzyme disturbances are early stages of a disease process which may eventually result in the clinical symptoms of lead poisoning. Whether or not the effects do progress to the later stages of clinical disease, disruption of these enzyme processes over a working lifetime is considered to be a material impairment of health.

d) One of the eventual results of lead-induced inhibition of enzymes in the heme synthesis pathway is anemia which can be asymptomatic if mild but associated with a wide array of symptoms including dizziness, fatigue, and tachycardia when more severe. Studies have indicated that lead levels as low as 50 µg/100g can be associated with a definite decreased hemoglobin, although most cases of lead-induced anemia, as well as shortened red-cell survival times, occur at lead levels exceeding 80 µg/100g. Inhibited hemoglobin synthesis is more common in chronic cases whereas shortened erythrocyte life span is more common in acute cases.

e) In lead-induced anemias, there is usually a reticulocytosis along with the presence of basophilic stippling, and ringed sideroblasts, although none of the above are pathognomonic for lead-induced anemia.

(II) Neurological effects.

a) Inorganic lead had been found to have toxic effects on both the central and peripheral nervous systems. The earliest stage of lead-induced central nervous system effects first manifest themselves in the form of behavioral disturbances and central nervous system symptoms including irritability, restlessness, insomnia and other sleep disturbances, fatigue, vertigo, headache, poor memory, tremor, depression, and apathy. With more severe exposure, symptoms can progress to drowsiness, stupor, hallucinations, delirium, convulsions and coma.

b) The most severe and acute form of lead poisoning which usually follows ingestion or inhalation of large amounts of lead is acute encephalopathy which may arise precipitously with the onset of intractable seizures, coma, cardiorespiratory arrest, and death within 48 hours.

c) While there is disagreement about what exposure levels are needed to produce the earliest symptoms, most experts agree that symptoms definitely can occur at blood lead levels of 60 µg/100g whole blood and therefore recommend a 40 µg/100g maximum. The central nervous system effects frequently are not reversible following discontinued exposure or chelation therapy and when improvement does occur, it is almost always only partial.

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d) The peripheral neuropathy resulting from lead exposure characteristically involves only motor function with minimal sensory damage and has a marked predilection for the extensor muscles of the most active extremity. The peripheral neuropathy can occur with varying degrees of severity. The earliest and mildest form which can be detected in workers with blood lead levels as low as 50 µg/100g is manifested by slowing or motor nerve conduction velocity often without clinical symptoms. With progression of the neuropathy there is development of painless extensor muscle weakness usually involving the extensor muscles of the fingers and hand in the most active upper extremity, followed in severe cases by wrist drop, much less commonly, foot drop.

e) In addition to slowing of nerve conduction, electromyographical studies in patients with blood lead levels greater than 50 µg/100g have demonstrated a decrease in the number of acting motor unit potentials, an increase in the duration of motor unit potentials, and spontaneous pathological activity including fibrillations and fasciculation. Whether these effects occur at levels of 40 µg/100g is undetermined.

f) While the peripheral neuropathies can occasionally be reversed with therapy, again such recovery is not assured particularly in the more severe neuropathies and often improvement is only partial. The lack of reversibility is felt to be due in part to segmental demyelination.

(III) Gastrointestinal. Lead may also effect the gastrointestinal system producing abdominal colic or diffuse abdominal pain, constipation, obstipation, diarrhea, anorexia, nausea and vomiting. Lead colic rarely develops at blood lead levels below 80 µg/100g.

(IV) Renal.

a) Renal toxicity represents one of the most serious health effects of lead poisoning. In the early stages of disease nuclear inclusion bodies can frequently be identified in proximal renal tubular cells. Renal functions remain normal and the changes in this stage are probably reversible. With more advanced disease there is progressive interstitial fibrosis and impaired renal function. Eventually extensive interstitial fibrosis ensues with sclerotic glomeruli and dilated and atrophied proximal tubules; all represent end stage kidney disease. Azotemia can be progressive, eventually resulting in frank uremia necessitating dialysis. There is occasionally associated hypertension and hyperuricemia with or without gout.

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b) Early kidney disease is difficult to detect. The urinalysis is normal in early lead nephropathy and the blood urea nitrogen and serum creatinine increase only when two-thirds of kidney function is lost. Measurement of creatinine clearance can often detect earlier disease as can other methods of measurement of glomerular filtration rate. An abnormal Ca-EDTA mobilization test has been used to differentiate between lead-induced and other nephropathies, but this procedure is not widely accepted. A form of Fanconi syndrome with aminoaciduria, glycosuria, and hyperphosphaturia indicating severe injury to the proximal renal tubules is occasionally seen in children.

(V) Reproductive effects.

a) Exposure to lead can have serious effects on reproductive function in both males and females. In male workers exposed to lead there can be a decrease in sexual drive, impotence, decreased ability to produce healthy sperm, and sterility. Malformed sperm (teratospermia), decreased number of sperm (hypospermia), and sperm with decreased motility (asthenospermia) can occur. Teratospermia has been noted at mean blood lead levels of 53 µg/100g and hypospermia and asthenospermia at 41 µg/100g. Furthermore, there appears to be a dose-response relationship for teratospermia in lead exposed workers.

b) Women exposed to lead may experience menstrual disturbances including dysmenorrhea, menorrhagia and amenorrhea. Following exposure to lead, women have a higher frequency of sterility, premature births, spontaneous miscarriages, and stillbirths.

c) Germ cells can be affected by lead and cause genetic damage in the egg or sperm cells before conception and result in failure to implant, miscarriage, stillbirth, or birth defects.

d) Infants of mothers with lead poisoning have a higher mortality during the first year and suffer from lowered birth weights, slower growth, and nervous system disorders.

e) Lead can pass through the placental barrier and lead levels in the mother's blood are comparable to concentrations of lead in the umbilical cord at birth. Transplacental passage becomes detectable at 12-14 weeks of gestation and increases until birth.

f) There is little direct data on damage to the fetus from exposure to lead but it is generally assumed that the fetus and newborn would be at least as susceptible to neurological damage as young children. Blood lead levels of 50-60 µg/100g in children can cause significant neurobehavioral impairments, and there is evidence of hyperactivity at blood levels as low as 25 µg/100g.

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Given the overall body of literature concerning the adverse health effects of lead in children, WISHA feels that the blood lead level in children should be maintained below 30 µg/100g with a population mean of 15 µg/100g. Blood lead levels in the fetus and newborn likewise should not exceed 30 µg/100g.

g) Because of lead's ability to pass through the placental barrier and also because of the demonstrated adverse effects of lead on reproductive function in both males and females as well as the risk of genetic damage of lead on both the ovum and sperm, WISHA recommends a 30 µg/100g maximum permissible blood lead level in both males and females who wish to bear children.

(IV) Other toxic effects.

a) Debate and research continue on the effects of lead on the human body. Hypertension has frequently been noted in occupationally exposed individuals although it is difficult to assess whether this is due to lead's adverse effects on the kidneys or if some other mechanism is involved.

b) Vascular and electrocardiographic changes have been detected but have not been well characterized. Lead is thought to impair thyroid function and interfere with the pituitary-adrenal axis, but again these effects have not been well defined.

(iv) Medical evaluation.

(A) The most important principle in evaluating a worker for any occupational disease including lead poisoning is a high index of suspicion on the part of the examining physician. As discussed in Section (ii), lead can affect numerous organ systems and produce a wide array of signs and symptoms, most of which are nonspecific and subtle in nature at least in the early stages of disease. Unless serious concern for lead toxicity is present, many of the early clues to diagnosis may easily be overlooked.

(B) The crucial initial step in the medical evaluation is recognizing that a worker's employment can result in exposure to lead. The worker will frequently be able to define exposures to lead and lead-containing materials but often will not volunteer this information unless specifically asked. In other situations the worker may not know of any exposures to lead but the suspicion might be raised on the part of the physician because of the industry or occupation of the worker. Potential occupational exposure to lead and its compounds occur in at least 120 occupations, including lead smelting, the manufacture of lead storage batteries, the manufacture of lead pigments and products containing pigments, solder manufacture, shipbuilding and ship repair, auto manufacturing, construction, and painting.

(C) Once the possibility for lead exposure is raised, the focus can then be directed toward eliciting information from the medical history, physical exam, and finally from laboratory data to evaluate the worker for potential lead toxicity.

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(D) A complete and detailed work history is important in the initial evaluation. A listing of all previous employment with information on work processes, exposure to fumes or dust, known exposures to lead or other toxic substances, respiratory protection used, and previous medical surveillance should all be included in the worker's record. Where exposure to lead is suspected, information concerning on-the-job personal hygiene, smoking or eating habits in work areas, laundry procedures, and use of any protective clothing or respiratory protection equipment should be noted. A complete work history is essential in the medical evaluation of a worker with suspected lead toxicity, especially when long-term effects such as neurotoxicity and nephrotoxicity are considered.

(E) The medical history is also of fundamental importance and should include a listing of all past and current medical conditions, current medications including proprietary drug intake, previous surgeries and hospitalizations, allergies, smoking history, alcohol consumption, and also nonoccupational lead exposures such as hobbies (hunting, riflery). Also known childhood exposures should be elicited. Any previous history of hematological, neurological, gastrointestinal, renal, psychological, gynecological, genetic, or reproductive problems should be specifically noted.

(F) A careful and complete review of systems must be performed to assess both recognized complaints and subtle or slowly acquired symptoms which the worker might not appreciate as being significant. The review of symptoms should include the following:

General	weight loss, fatigue, decreased appetite.
Head, Eyes, Ears, Nose, Throat (HEENT)	Headaches, visual disturbance or decreased visual acuity, hearing deficits or tinnitus, pigmentation of the oral mucosa, or metallic taste in mouth.
Cardio-pulmonary	Shortness of breath, cough, chest pains, palpitations, or orthopnea.
Gastrointestinal	nausea, vomiting, heartburn, abdominal pain, constipation or diarrhea.
Neurologic	Irritability, insomnia, weakness (fatigue), dizziness, loss of memory, confusion, hallucinations, incoordination, ataxia, decreased strength in hands or feet, disturbance in gait, difficulty in climbing stairs, or seizures.
Hematologic	pallor, easy fatigability, abnormal blood loss, melena.
Reproductive (male or female and spouse where relevant)	history of infertility, impotence, loss of libidio, abnormal menstrual periods, history of miscarriages, stillbirths, or children with birth defects.
Musculo-skeletal	muscle and joint pains.

(G) The physical examination should emphasize the neurological, gastrointestinal, and cardiovascular systems. The worker's weight and blood pressure should be recorded and the oral mucosa checked for pigmentation characteristic of a possible Burtonian or lead line on the gingiva. It should be noted, however, that the lead line may not be present even in severe lead poisoning if good oral hygiene is practiced.

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(H) The presence of pallor on skin examination may indicate an anemia, which if severe might also be associated with a tachycardia. If an anemia is suspected, an active search for blood loss should be undertaken including potential blood loss through the gastrointestinal tract.

(I) A complete neurological examination should include an adequate mental status evaluation including a search for behavioral and psychological disturbances, memory testing, evaluation for irritability, insomnia, hallucinations, and mental clouding. Gait and coordination should be examined along with close observation for tremor. A detailed evaluation of peripheral nerve function including careful sensory and motor function testing is warranted. Strength testing particularly of extensor muscle groups of all extremities is of fundamental importance.

(J) Cranial nerve evaluation should also be included in the routine examination.

(K) The abdominal examination should include auscultation for bowel sounds and abnormal bruits and palpation for organomegaly, masses, and diffuse abdominal tenderness.

(L) Cardiovascular examination should evaluate possible early signs of congestive hear failure. Pulmonary status should be addressed particularly if respirator protection is contemplated.

(M) As part of the medical evaluation, the lead standard requires the following laboratory studies.

(I) Blood lead level.

(II) Hemoglobin and hematocrit determinations, red cell indices, and examination of the peripheral blood smear to evaluate red blood cell morphology.

(III) Blood urea nitrogen.

(IV) Serum creatinine.

(V) Routine urinalysis with microscopic examination.

(VI) A zinc protoporphyrin level.

(N) In addition to the above, the physician is authorized to order any further laboratory or other tests which he or she deems necessary in accordance with sound medical practice. The evaluation must also include pregnancy testing or laboratory evaluation of male fertility if requested by the employee.

(O) Additional tests which are probably not warranted on a routine basis but may be appropriate when blood lead and ZPP levels are equivocal include delta aminolevulinic acid and coproporphyrin concentrations in the urine, and dark-field illumination for detection of basophilic stippling in red blood cells.

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(P) If an anemia is detected further studies including a careful examination of the peripheral smear, reticulocyte count, stool for occult blood, serum iron, total iron binding capacity, bilirubin, and, if appropriate vitamin B12 and folate may be of value in attempting to identify the cause of the anemia.

(Q) If a peripheral neuropathy is suspected, nerve conduction studies are warranted both for diagnosis and as a basis to monitor any therapy.

(R) If renal disease is questioned, a 24-hour urine collection for creatinine clearance, protein, and electrolytes may be indicated. Elevated uric acid levels may result from lead-induced renal disease and a serum uric acid level might be performed.

(S) An electrocardiogram and chest x-ray may be obtained as deemed appropriate.

(T) Sophisticated and highly specialized testing should not be done routinely and where indicated should be under the direction of a specialist.

(v) Laboratory evaluation.

(A) The blood level at present remains the single most important test to monitor lead exposure and is the test used in the medical surveillance program under the lead standard to guide employee medical removal. The ZPP has several advantages over the blood lead level. Because of its relatively recent development and the lack of extensive data concerning its interpretation, the ZPP currently remains an ancillary test.

(B) This section will discuss the blood lead level and ZPP in detail and will outline their relative advantages and disadvantages. Other blood tests currently available to evaluate lead exposure will also be reviewed.

(C) The blood lead level is a good index of current or recent lead absorption when there is no anemia present and when the worker has not taken any chelating agents. However, blood lead levels along with urinary lead levels do not necessarily indicate the total body burden of lead and are not adequate measures of past exposure. One reason for this is that lead has a high affinity for bone and up to 90 percent of the body's total lead is deposited there. A very important component of the total lead body burden is lead in soft tissue (liver, kidneys, and brain). This fraction of the lead body burden, the biologically active lead, is not entirely reflected by blood lead levels since it is a function of the dynamics of lead absorption, distribution, deposition in bone and excretion. Following discontinuation of exposure to lead, the excess body burden is only slowly mobilized from bone and other relatively stable stores and excreted. Consequently, a high blood lead level may only represent recent heavy exposure to lead without a significant total body excess and likewise a low blood lead level does not exclude an elevated total body burden of lead.

(D) Also due to its correlation with recent exposures, the blood lead level may vary considerably over short time intervals.

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(E) To minimize laboratory error and erroneous results due to contamination, blood specimens must be carefully collected after thorough cleaning of the skin with appropriate methods using lead-free containers and analyzed by a reliable laboratory. Under the standard, samples must be analyzed in laboratories which are approved by the Center for Disease Control (CDC) or which have received satisfactory grades in proficiency testing by the CDC in the previous year. Analysis is to be made using atomic absorption spectrophotometry anodic stripping; voltammetry or any method which meets the accuracy requirements set forth by the standard.

(F) The determination of lead in urine is generally considered a less reliable monitoring technique than analysis of whole blood primarily due to individual variability in urinary excretion capacity as well as the technical difficulty of obtaining accurate 24 hour urine collections. In addition, workers with renal insufficiency, whether due to lead or some other cause, may have decreased lead clearance and consequently urine lead levels may underestimate the true lead burden. Therefore, urine lead levels should not be used as a routine test.

(G) The zinc protoporphyrin test, unlike the blood lead determination, measures an adverse metabolic effect of lead and as such is a better indicator of lead toxicity than the level of blood lead itself. The level of ZPP reflects lead absorption over the preceding three to four months, and therefore is a better indicator of lead body burden. The ZPP requires more time than the blood lead to read significantly elevated levels; the return to normal after discontinuing lead exposure is also slower. Furthermore, the ZPP test is simpler, faster, and less expensive to perform and no contamination is possible. Many investigators believe it is the most reliable means of monitoring chronic lead absorption.

(H) Zinc protoporphyrin results from the inhibition of the enzyme ferrochelatase which catalyzes the insertion of an iron molecule into the protoporphyrin molecule, which then becomes heme. If iron is not inserted into the molecule then zinc, having a greater affinity for protoporphyrin, takes place in the iron, forming ZPP.

(I) An elevation in the level of circulating ZPP may occur at blood lead levels as low as 20-30 µg/100g in some workers. Once the blood lead level has reached 40 µg/100g there is more marked rise in the ZPP value from its normal range of less than 100 µg/100ml. Increases in blood lead levels beyond 40 µg/100g are associated with exponential increases in ZPP.

(J) Whereas blood lead levels fluctuate over short time spans, ZPP levels remain relatively stable. ZPP is measured directly in red blood cells and is present for the cell's entire 120 day lifespan. Therefore, the ZPP level in blood reflects the average ZPP production over the previous three to four months and consequently the average lead exposure during that time interval.

(K) It is recommended that a hematocrit be determined whenever a confirmed ZPP of 50 µg/100ml whole blood is obtained to rule out a significant underlying anemia. If the ZPP is in excess of 100µg/100ml and not associated with abnormal elevations in blood lead levels, the laboratory should be checked to be sure the blood leads were determined using atomic absorption

spectrophotometry, anodic stripping voltammetry or any method which meets the accuracy requirements set forth by the standard, by a CDC approved laboratory which is experienced in lead level determinations. Repeat periodic blood lead studies should be obtained in all individuals with elevated ZPP levels to be certain that an associated elevated blood lead level has not been missed due to transient fluctuations in blood leads.

(L) ZPP has characteristic fluorescence spectrum with a peak at 594nm which is detectable with a hematofluorimeter. The hematofluorimeter is accurate and portable and can provide on-site, instantaneous results for workers who can be frequently tested via a finger prick.

(M) However, careful attention must be given to calibration and quality control procedures. Limited data on blood lead - ZPP correlations and the ZPP levels which are associated with the adverse health effects discussed in item (ii) are the major limitations of the test. Also it is difficult to correlate ZPP levels with environmental exposure and there is some variation of response with age and sex. Nevertheless, the ZPP promises to be an important diagnostic test for the early detection of lead toxicity and its value will increase as more data is collected regarding its relationship to other manifestations of lead poisoning.

(N) Levels of delta-aminolevulinic acid (ALA) in the urine are also used as a measure of lead exposure. Increasing concentrations of ALA are believed to result from the inhibition of the enzyme delta-aminolevulinic acid dehydrase (ALA-D). Although the test is relatively easy to perform, inexpensive, and rapid, the disadvantages include variability in results, the necessity to collect a complete 24 hour urine sample which has a specific gravity greater than 1.010, and also the fact that ALA decomposes in the presence of light.

(O) The pattern of porphyrin excretion in the urine can also be helpful in identifying lead intoxication. With lead poisoning, the urine concentrations of coproporphyrins I and II, porphobilinogen and uroporphyrin I rise. The most important increase, however, is that of coproporphyrin III; levels may exceed 5,000 µg/1 in the urine in lead poisoned individuals, but its correlation with blood lead levels and ZPP are not as good as those of ALA. Increases in urinary porphyrins are not diagnostic of lead toxicity and may be seen in porphyria, some liver diseases, and in patients with high reticulocyte counts.

(vi) Summary.

(A) The WISHA standard for inorganic lead places significant emphasis on the medical surveillance of all workers exposed to levels of inorganic lead above the action level of 30 $\mu g/m^3$ TWA. The physician has a fundamental role in this surveillance program, and in the operation of the medical removal protection program.

(B) Even with adequate worker education on the adverse health effects of lead and appropriate training in work practices, personal hygiene and other control measures, the physician has a primary responsibility for evaluating potential lead toxicity in the worker. It is only through a careful and detailed medical and work history, a complete physical examination and appropriate laboratory

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testing that an accurate assessment can be made. Many of the adverse health effects of lead toxicity are either irreversible or only partially reversible and therefore early detection of disease is very important.

(C) This document outlines the medical monitoring program as defined by the occupational safety and health standard for inorganic lead. It reviews the adverse health effects of lead poisoning and describes the important elements of the history and physical examinations as they relate to these adverse effects.

(D) It is hoped that this review and discussion will give the physician a better understanding of the WISHA standard with the ultimate goal of protecting the health and well-being of the worker exposed to lead under his or her care.

(d) Appendix D. **Recommendations to employers concerning high-risk tasks (nonmandatory).**

The department advises employers that the following tasks have a high risk for lead overexposure (this list is not complete; other tasks also can result in lead over-exposure):

- Any open flame operation involving lead-containing solder in a manner producing molten solder, including the manufacture or repair of motor vehicle radiators;
- Sanding, cutting or grinding of lead-containing solder;
- Breaking, recycling or manufacture of lead-containing batteries;
- Casting objects using lead, brass, or lead-containing alloys;
- Where lead-containing coatings or paints are present:
    - abrasive blasting
    - welding
    - cutting
    - torch burning
    - manual demolition of structures
    - manual scraping
    - manual sanding
    - heat gun applications
    - power tool cleaning
    - rivet busting
    - clean-up activities where dry expendable abrasives are used
    - abrasive blasting enclosure movement and removal;
- Spray-painting with lead-containing paint;
- Using lead-containing mortar;
- Lead burning;
- Operation or cleaning of shooting facilities where lead bullets are used;
- Formulation or processing of lead-containing pigments or paints;
- Cutting, burning, or melting of lead-containing materials.

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The department recommends that annual blood lead testing be offered to all employees potentially overexposed to lead, including those performing the tasks listed above, regardless of air lead levels. Research has shown that air lead levels often do not accurately predict workers' lead overexposure. The blood lead testing will provide the most information if performed during a period of peak lead exposure.

Employers should be aware that the United States Public Health Service has set a goal of eliminating occupational exposures which result in whole blood lead levels of 25 µg/dl or greater. This goal should guide whether employees' blood lead levels indicate lead overexposure.

If blood lead levels are elevated in an employee performing a task associated with lead overexposure, employers should assess the maintenance and effectiveness of exposure controls, hygiene facilities, respiratory protection program, the employee's work practices and personal hygiene, and the employee's respirator use, if any. If a deficiency exists in any of these areas, the employer should correct the problem.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07521, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07521, filed 05/04/99, effective 09/01/99. Statutory Authority: Chapter 49.17 RCW. 96-09-030, 296-62-07521, filed 4/10/96, effective 6/1/96; 95-04-078, 296-62-07521, filed 1/30/95, effective 3/2/95; 91-24-017 (Order 91-07), 296-62-07521, filed 11/22/91, effective 12/24/91; 90-17-051 (Order 90-10), 296-62-07521, filed 8/13/90, effective 9/24/90; 90-03-029 (Order 89-20), 296-62-07521, filed 1/11/90, effective 2/26/90; 88-14-108 (Order 88-11), 296-62-07521, filed 7/6/88. Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-07521, filed 11/30/83; 82-13-045 (Order 82-22), 296-62-07521, filed 6/11/82. Formerly WAC 296-62-07349.]

WAC 296-62-07523 Benzene.

(1) **Scope and application.**

(a) This section applies to all occupational exposures to benzene. Chemical Abstracts Service Registry No. 71-43-2, except as provided in (b) and (c) of this subsection.

(b) This section does not apply to:

(i) The storage, transportation, distribution, dispensing, sale or use of gasoline, motor fuels, or other fuels containing benzene subsequent to its final discharge from bulk wholesale storage facilities, except that operations where gasoline or motor fuels are dispensed for more than four hours per day in an indoor location are covered by this section.

(ii) Loading and unloading operations at bulk wholesale storage facilities which use vapor control systems for all loading and unloading operations, except for the provisions of WAC 296-62-054 and WAC 296-800-170 as incorporated into this section and the emergency provisions of subsections (7) and (9)(d) of this section.

(iii) The storage, transportation, distribution, or sale of benzene or liquid mixtures containing more than 0.1 percent benzene in intact containers or in transportation pipelines while sealed in such a manner as to contain benzene vapors or liquid, except for the provisions of WAC 296-62-054 and WAC 296-800-170 as incorporated into this section and the emergency provisions of subsections (7) and (9)(d) of this section.

(iv) Containers and pipelines carrying mixtures with less than 0.1 percent benzene and natural gas processing plants processing gas with less than 0.1 percent benzene.

(v) Work operations where the only exposure to benzene is from liquid mixtures containing 0.5 percent or less of benzene by volume, or the vapors released from such liquids until September 12, 1988; work operations where the only exposure to benzene is from liquid

mixtures containing 0.3 percent or less of benzene by volume or the vapors released from such liquids from September 12, 1988, to September 12, 1989; and work operations where the only exposure to benzene is from liquid mixtures containing 0.1 percent or less of benzene by volume or the vapors released from such liquids after September 12, 1989; except that tire building machine operators using solvents with more than 0.1 percent benzene are covered by subsection (9) of this section.

(vi) Oil and gas drilling, production, and servicing operations.

(vii) Coke oven batteries.

(c) The cleaning and repair of barges and tankers which have contained benzene are excluded from subsection (6) of this section (Methods of compliance), subsection (5)(a) of this section (General), and subsection (5)(f) of this section (Accuracy of monitoring). Engineering and work practice controls shall be used to keep exposures below 10 ppm unless it is proven to be not feasible.

(2) **Definitions.**

(a) **"Action level"** means an airborne concentration of benzene of 0.5 ppm calculated as an 8-hour time-weighted average.

(b) **"Authorized person"** means any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees for the purpose of exercising the right to observe monitoring and measuring procedures under subsection (5) of this section, or any other person authorized by the Washington Industrial Safety and Health Act (WISHA) or regulations issued under WISHA.

(c) **"Benzene"** (C6H6) (CAS Registry No. 71-43-2) means liquefied or gaseous benzene. It includes benzene contained in liquid mixtures and the benzene vapors released by these liquids. It does not include trace amounts of unreacted benzene contained in solid materials.

(d) **"Bulk wholesale storage facility"** means a bulk terminal or bulk plant where fuel is stored prior to its delivery to wholesale customers.

(e) **"Container"** means any barrel, bottle, can, cylinder, drum, reaction vessel, storage tank, or the like, but does not include piping systems.

(f) **"Day"** means any part of a calendar day.

(g) **"Director"** means the director of the department of labor and industries, or his/her designated representative.

(h) **"Emergency"** means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which may or does result in an unexpected significant release of benzene.

(i) **"Employee exposure"** means exposure to airborne benzene which would occur if the employee were not using respiratory protective equipment.

(j) **"Regulated area"** means any area where airborne concentrations of benzene exceed or can reasonably be expected to exceed, the permissible exposure limits, either the 8-hour time-weighted average exposure of 1 ppm or the short-term exposure limit of 5 ppm for fifteen minutes.

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(k) **"Vapor control system"** means any equipment used for containing the total vapors displaced during the loading of gasoline, motor fuel, or other fuel tank trucks and the displacing of these vapors through a vapor processing system or balancing the vapor with the storage tank. This equipment also includes systems containing the vapors displaced from the storage tank during the unloading of the tank truck which balance the vapors back to the tank truck.

(3) **Permissible exposure limits (PELs).**

(a) Time-weighted average limit (TWA). The employer shall assure that no employee is exposed to an airborne concentration of benzene in excess of one part of benzene per million parts of air (1 ppm) as an 8-hour time-weighted average.

(b) Short-term exposure limit (STEL). The employer shall assure that no employee is exposed to an airborne concentration of benzene in excess of 5 ppm as averaged over any fifteen minute period.

(4) **Regulated areas.**

(a) The employer shall establish a regulated area wherever the airborne concentration of benzene exceeds or can reasonably be expected to exceed the permissible exposure limits, either the 8-hour time-weighted average exposure of 1 ppm or the short-term exposure limit of 5 ppm for fifteen minutes.

(b) Access to regulated areas shall be limited to authorized persons.

(c) Regulated areas shall be determined from the rest of the workplace in any manner that minimizes the number of employees exposed to benzene within the regulated area.

(5) **Exposure monitoring.**

(a) General.

(i) Determinations of employee exposure shall be made from breathing zone air samples that are representative of each employee's average exposure to airborne benzene.

(ii) Representative 8-hour TWA employee exposures shall be determined on the basis of one sample or samples representing the full shift exposure for each job classification in each work area.

(iii) Determinations of compliance with the STEL shall be made from fifteen minute employee breathing zone samples measured at operations where there is reason to believe exposures are high, such as where tanks are opened, filled, unloaded, or gauged; where containers or process equipment are opened and where benzene is used for cleaning or as a solvent in an uncontrolled situation. The employer may use objective data, such as measurements from brief period measuring devices, to determine where STEL monitoring is needed.

(iv) Except for initial monitoring as required under (b) of this subsection, where the employer can document that one shift will consistently have higher employee exposures for an operation, the employer shall only be required to determine representative employee exposure for that operation during the shift on which the highest exposure is expected.

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(b) Initial monitoring.

(i) Each employer who has a place of employment covered under subsection (1)(a) of this section shall monitor each of these workplaces and work operations to determine accurately the airborne concentrations of benzene to which employees may be exposed.

(ii) The initial monitoring required under (b)(i) of this subsection shall be completed by sixty days after the effective date of this standard or within thirty days of the introduction of benzene into the workplace. Where the employer has monitored within one year prior to the effective date of this standard and the monitoring satisfies all other requirements of this section, the employer may rely on such earlier monitoring results to satisfy the requirements of (b)(i) of this subsection.

(c) Periodic monitoring and monitoring frequency.

(i) If the monitoring required by (b)(i) of this subsection reveals employee exposure at or above the action level but at or below the TWA, the employer shall repeat such monitoring for each such employee at least every year.

(ii) If the monitoring required by (b)(i) of this subsection reveals employee exposure above the TWA, the employer shall repeat such monitoring for each such employee at least every six months.

(iii) The employer may alter the monitoring schedule from every six months to annually for any employee for whom two consecutive measurements taken at least seven days apart indicate that the employee exposure has decreased to the TWA or below, but is at or above the action level.

(iv) Monitoring for the STEL shall be repeated as necessary to evaluate exposures of employees subject to short term exposures.

(d) Termination of monitoring.

(i) If the initial monitoring required by (b)(i) of this subsection reveals employee exposure to be below the action level the employer may discontinue the monitoring for that employee, except as otherwise required by (e) of this subsection.

(ii) If the periodic monitoring required by (c) of this subsection reveals that employee exposures, as indicated by at least two consecutive measurements taken at least seven days apart, are below the action level the employer may discontinue the monitoring for that employee, except as otherwise required by (e) of this subsection.

(e) Additional monitoring.

(i) The employer shall institute the exposure monitoring required under (b) and (c) of this subsection when there has been a change in the production, process, control equipment, personnel, or work practices which may result in new or additional exposures to benzene, or when the employer has any reason to suspect a change which may result in new or additional exposures.

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(ii) Whenever spills, leaks, ruptures, or other breakdowns occur that may lead to employee exposure, the employer shall monitor (using area or personal sampling) after the cleanup of the spill or repair of the leak, rupture or other breakdown to ensure that exposures have returned to the level that existed prior to the incident.

(f) Accuracy of monitoring. Monitoring shall be accurate, to a confidence level of ninety-five percent, to within plus or minus twenty-five percent for airborne concentrations of benzene.

(g) Employee notification of monitoring results.

(i) The employer shall, within fifteen working days after the receipt of the results of any monitoring performed under this standard, notify each employee of these results in writing either individually or by posting of results in an appropriate location that is accessible to affected employees.

(ii) Whenever the PELs are exceeded, the written notification required by (g)(i) of this subsection shall contain the corrective action being taken by the employer to reduce the employee exposure to or below the PEL, or shall refer to a document available to the employee which states the corrective actions to be taken.

(6) **Methods of compliance.**

(a) Engineering controls and work practices.

(i) The employer shall institute engineering controls and work practices to reduce and maintain employee exposure to benzene at or below the permissible exposure limits, except to the extent that the employer can establish that these controls are not feasible or where the provisions of (a)(iii) of this subsection or subsection (7)(a) of this section apply.

(ii) Wherever the feasible engineering controls and work practices which can be instituted are not sufficient to reduce employee exposure to or below the PELs, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of subsection (7) of this section.

(iii) Where the employer can document that benzene is used in a workplace less than a total of thirty days per year, the employer shall use engineering controls, work practice controls or respiratory protection or any combination of these controls to reduce employee exposure to benzene to or below the PELs, except that employers shall use engineering and work practice controls, if feasible, to reduce exposure to or below 10 ppm as an 8-hour TWA.

(b) Compliance program.

(i) When any exposures are over the PEL, the employer shall establish and implement a written program to reduce employee exposure to or below the PEL primarily by means of engineering and work practice controls, as required by (a) of this subsection.

(ii) The written program shall include a schedule for development and implementation of the engineering and work practice controls. These plans shall be reviewed and revised as appropriate based on the most recent exposure monitoring data, to reflect the current status of the program.

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(iii) Written compliance programs shall be furnished upon request for examination and copying to the director, affected employees, and designated employee representatives.

(7) **Respiratory protection.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls;

(ii) Work operations for which the employer establishes that compliance with either the TWA or STEL through the use of engineering and work-practice controls is not feasible; for example some maintenance and repair activities, vessel cleaning, or other operations where engineering and work-practice controls are infeasible because exposures are intermittent and limited in duration;

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient, or are not required under subsection (6)(a)(iii) of this section, to reduce exposure to or below the PELs;

(iv) Emergencies.

(b) Respirator program.

(i) The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1), 296-62-07131(4)(b)(i) and (ii), and 296-62-07150 through 296-62-07156).

(ii) For air-purifying respirators, the employer must replace the air-purifying element at the expiration of its service life or at the beginning of each shift in which such elements are used, whichever comes first.

(iii) If NIOSH certifies an air-purifying element with an end-of-service-life indicator for benzene, such an element may be used until the indicator shows no further useful life.

(c) Respirator selection.

(i) The employer must select the appropriate respirator from Table 1 of this section.

(ii) Any employee who cannot use a negative-pressure respirator must be allowed to use a respirator with less breathing resistance, such as a powered air-purifying respirator or supplied-air respirator.

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TABLE 1 – RESPIRATORY PROTECTION FOR BENZENE

Airborne concentrations of Benzene or condition of use		Respirator Type	
(a)	Less than or equal to 10 ppm.	(1)	Full facepiece respirator with organic vapor cartridges.
(b)	Less than or equal to 50 ppm.	(1) (2)	Full facepiece respirator with organic vapor cartridges Full facepiece gas mask with chin style canister.
(c)	Less than or equal to 100 ppm.	(1)	Full facepiece powered aid purifying respirator with organic vapor canister.[1]
(d)	Less than or equal to 1,000 ppm.	(1)	Supplied-air respirator with full facepiece in positive-pressure mode.
(e)	Greater than 1,000 ppm or Unknown concentration.	(1) (2)	Self-contained breathing apparatus with full facepiece in positive-pressure mode. Full facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
(f)	Escape	(1) (2)	Any organic vapor gas mask; or Any self-contained breathing apparatus with full facepiece.
(g)	Firefighting	(1)	Full facepiece self-contained breathing apparatus in positive-pressure mode.

[1] Canisters must have a minimum service life of four (4) hours when tested at 150 ppm benzene, at a flow rate of 64 LPM, 25% C, and 85% relative humidity for non-powered air purifying respirators. The flow rate shall be 115 LPM and 170 LPM respectively for tight fitting and loose fitting powered air-purifying respirators.

(8) **Protective clothing and equipment.** Personal protective clothing and equipment shall be worn where appropriate to prevent eye contact and limit dermal exposure to liquid benzene. Protective clothing and equipment shall be provided by the employer at no cost to the employee and the employer shall assure its use where appropriate. Eye and face protection shall met the requirements of WAC 296-800-160.

(9) **Medical surveillance.**

(a) General.

(i) The employer shall make available a medical surveillance program for employees who are or may be exposed to benzene at or above the action level thirty or more days per year; for employees who are or may be exposed to benzene at or above the PELs ten or more days per year; for employees who have been exposed to more than 10 ppm of benzene for thirty or more days in a year prior to the effective date of the standard when employed by their current employer; and for employees involved in the tire building operations called tire building machine operators, who use solvents containing greater than 0.1 percent benzene.

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(ii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician and that all laboratory tests are conducted by an accredited laboratory.

(iii) The employer shall assure that persons other than licensed physicians who administer the pulmonary function testing required by this section shall complete a training course in spirometry sponsored by an appropriate governmental, academic, or professional institution.

(iv) The employer shall assure that all examinations and procedures are provided without cost to the employee and at a reasonable time and place.

(b) Initial examination.

(i) Within sixty days of the effective date of this standard, or before the time of initial assignment, the employer shall provide each employee covered by (a)(i) of this subsection with a medical examination including the following elements:

(A) A detailed occupational history which includes:

(I) Past work exposure to benzene or any other hematological toxins;

(II) A family history of blood dyscrasias including hematological neoplasms;

(III) A history of blood dyscrasias including genetic hemoglobin abnormalities, bleeding abnormalities, abnormal function of formed blood elements;

(IV) A history of renal or liver dysfunction;

(V) A history of medicinal drugs routinely taken;

(VI) A history of previous exposure to ionizing radiation; and

(VII) Exposure to marrow toxins outside of the current work situation.

(B) A complete physical examination.

(C) Laboratory tests. A complete blood count including a leukocyte count with differential, a quantitative thrombocyte count, hematocrit, hemoglobin, erythrocyte count and erythrocyte indices (MCV, MCH, MCHC). The results of these tests shall be reviewed by the examining physician.

(D) Additional tests as necessary in the opinion of the examining physician, based on alterations to the components of the blood or other signs which may be related to benzene exposure.

(E) For all workers required to wear respirators for at least thirty days a year, the physical examination shall pay special attention to the cardiopulmonary system and shall include a pulmonary function test.

WAC 296-62-07523 (Cont.)

(ii) No initial medical examination is required to satisfy the requirements of (b)(i) of this subsection if adequate records show that the employee has been examined in accordance with the procedures of (b)(i) of this subsection within the twelve months prior to the effective date of this standard.

(c) Periodic examinations.

(i) The employer shall provide each employee covered under (a)(i) of this subsection with a medical examination annually following the previous examination. These periodic examinations shall include at least the following elements:

(A) A brief history regarding any new exposure to potential marrow toxins, changes in medicinal drug use, and the appearance of physical signs relating to blood disorders;

(B) A complete blood count including a leukocyte count with differential, quantitative thrombocyte count, hemoglobin, hematocrit, erythrocyte count and erythrocyte indices (MCV, MCH, MCHC); and

(C) Appropriate additional tests as necessary, in the opinion of the examining physician, in consequence of alterations in the components of the blood or other signs which may be related to benzene exposure.

(ii) Where the employee develops signs and symptoms commonly associated with toxic exposure to benzene, the employer shall provide the employee with an additional medical examination which shall include those elements considered appropriate by the examining physician.

(iii) For persons required to use respirators for at least thirty days a year, a pulmonary function test shall be performed every three years. A specific evaluation of the cardiopulmonary system shall be made at the time of the pulmonary function test.

(d) Emergency examinations.

(i) In addition to the surveillance required by (a)(i) of this subsection, if an employee is exposed to benzene in an emergency situation, the employer shall have the employee provide a urine sample at the end of the employee's shift and have a urinary phenol test performed on the sample within seventy-two hours. The urine specific gravity shall be corrected to 1.024.

(ii) If the result of the urinary phenol test is below 75 mg phenol/L of urine, no further testing is required.

(iii) If the result of the urinary phenol test is equal to or greater than 75 mg phenol/L of urine, the employer shall provide the employee with a complete blood count including an erythrocyte count, leukocyte count with differential and thrombocyte count at monthly intervals for a duration of three months following the emergency exposure.

(iv) If any of the conditions specified in (e)(i) of this subsection exists, then the further requirements of (e) of this subsection shall be met and the employer shall, in addition, provide the employees with periodic examinations if directed by the physician.

WAC 296-62-07523 (Cont.)

(e) Additional examinations and referrals.

(i) Where the results of the complete blood count required for the initial and periodic examinations indicate any of the following abnormal conditions exist, then the blood count shall be repeated within two weeks.

(A) The hemoglobin level or the hematocrit falls below the normal limit (outside the ninety-five percent confidence interval (C.I.)) as determined by the laboratory for the particular geographic area and/or these indices show a persistent downward trend from the individual's preexposure norms; provided these findings cannot be explained by other medical reasons.

(B) The thrombocyte (platelet) count varies more than twenty percent below the employee's most recent values or falls outside the normal limit (ninety-five percent C.I.) as determined by the laboratory.

(C) The leukocyte count is below 4,000 per mm^3 or there is an abnormal differential count.

(ii) If the abnormality persists, the examining physician shall refer the employee to a hematologist or an internist for further evaluation unless the physician has good reason to believe such referral is unnecessary. (See Appendix C for examples of conditions where a referral may be unnecessary.)

(iii) The employer shall provide the hematologist or internist with the information required to be provided to the physician under this subsection and the medical record required to be maintained by subsection (11)(b)(ii) of this section.

(iv) The hematologist's or internist's evaluation shall include a determination as to the need for additional tests, and the employer shall assure that these tests are provided.

(f) Information provided to the physician. The employer shall provide the following information to the examining physician:

(i) A copy of this regulation and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's actual or representative exposure level;

(iv) A description of any personal protective equipment used or to be used; and

(v) Information from previous employment-related medical examinations of the affected employee which is not otherwise available to the examining physician.

(g) Physician's written opinions.

(i) For each examination under this section, the employer shall obtain and provide the employee with a copy of the examining physician's written opinion within fifteen days of the examination. The written opinion shall be limited to the following information:

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(A) The occupationally pertinent results of the medical examination and tests;

(B) The physician's opinion concerning whether the employee has any detected medical conditions which would place the employee's health at greater than normal risk of material impairment from exposure to benzene;

(C) The physician's recommended limitations upon the employee's exposure to benzene or upon the employee's use of protective clothing or equipment and respirators.

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions resulting from benzene exposure which require further explanation or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific records, findings, and diagnoses that have no bearing on the employee's ability to work in a benzene-exposed workplace.

(h) Medical removal plan.

(i) When a physician makes a referral to a hematologist/internist as required under (e)(ii) of this subsection, the employee shall be removed from areas where exposures may exceed the action level until such time as the physician makes a determination under (h)(ii) of this subsection.

(ii) Following the examination and evaluation by the hematologist/internist, a decision to remove an employee from areas where benzene exposure is above the action level or to allow the employee to return to areas where benzene exposure is above the action level shall be made by the physician in consultation with the hematologist/internist. This decision shall be communicated in writing to the employer and employee. In the case of removal, the physician shall state the required probable duration of removal from occupational exposure to benzene above the action level and the requirements for future medical examinations to review the decision.

(iii) For any employee who is removed pursuant to (h)(ii) of this subsection, the employer shall provide a follow-up examination. The physician, in consultation with the hematologist/internist, shall make a decision within six months of the date the employee was removed as to whether the employee shall be returned to the usual job or whether the employee should be removed permanently.

(iv) Whenever an employee is temporarily removed from benzene exposure pursuant to (h)(i) or (ii) of this subsection, the employer shall transfer the employee to a comparable job for which the employee is qualified (or can be trained for in a short period) and where benzene exposures are as low as possible, but in no event higher than the action level. The employer shall maintain the employee's current wage rate, seniority, and other benefits. If there is no such job available, the employer shall provide medical removal protection benefits until such a job becomes available or for six months, whichever comes first.

WAC 296-62-07523 (Cont.)

(v) Whenever an employee is removed permanently from benzene exposure based on a physician's recommendation pursuant to (h)(iii) of this subsection, the employee shall be given the opportunity to transfer to another position which is available or later becomes available for which the employee is qualified (or can be trained for in a short period) and where benzene exposures are as low as possible but in no event higher than the action level. The employer shall assure that such employee suffers no reduction in current wage rate, seniority, or other benefits as a result of the transfer.

(i) Medical removal protection benefits.

(i) The employer shall provide to an employee six months of medical removal protection benefits immediately following each occasion an employee is removed from exposure to benzene because of hematological findings pursuant to (h)(i) and (ii) of this subsection, unless the employee has been transferred to a comparable job where benzene exposures are below the action level.

(ii) For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that the employer shall maintain the current wage rate, seniority, and other benefits of an employee as though the employee had not been removed.

(iii) The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program, or from employment with another employer made possible by virtue of the employee's removal.

(10) **Communication of benzene hazards to employees.**

(a) Signs and labels.

(i) The employer shall post signs at entrances to regulated areas. The signs shall bear the following legend:

DANGER
BENZENE
CANCER HAZARD
FLAMMABLE-NO SMOKING
AUTHORIZED PERSONNEL ONLY
RESPIRATOR REQUIRED

(ii) The employer shall ensure that labels or other appropriate forms of warning are provided for containers of benzene within the workplace. There is no requirement to label pipes. The labels shall comply with the requirements of WAC 296-800-170 and in addition shall include the following legend:

DANGER
CONTAINS BENZENE
CANCER HAZARD

WAC 296-62-07523 (Cont.)

(b) Material safety data sheets.

(i) Employers shall obtain or develop, and shall provide access to their employees, to a material safety data sheet (MSDS) which addresses benzene and complies with WAC 296-62-054 and 296-800-170.

(ii) Employers who are manufacturers or importers shall:

(A) Comply with subsection (1) of this section; and

(B) Comply with the requirement in WISHA's hazard communication standard, WAC 296-62-054 (Hazard communication purpose), that they deliver to downstream employers an MSDS which addresses benzene.

(c) Information and training.

(i) The employer shall provide employees with information and training at the time of their initial assignment to a work area where benzene is present. If exposures are above the action level, employees shall be provided with information and training at least annually thereafter.

(ii) The training program shall be in accordance with the requirements of WAC 296-800-170, and shall include specific information on benzene for each category of information included in that section.

(iii) In addition to the information required under WAC 296-800-170, the employer shall:

(A) Provide employees with an explanation of the contents of this section, including Appendices A and B, and indicate to them where the standard is available; and

(B) Describe the medical surveillance program required under subsection (9) of this section, and explain the information contained in Appendix C.

(11) **Recordkeeping.**

(a) Exposure measurements.

(i) The employer shall establish and maintain an accurate record of all measurements required by subsection (5) of this section, in accordance with WAC 296-62-052.

(ii) This record shall include:

(A) The dates, number, duration, and results of each of the samples taken, including a description of the procedure used to determine representative employee exposures;

(B) A description of the sampling and analytical methods used;

(C) A description of the type of respiratory protective devices worn, if any; and

(D) The name, Social Security number, job classification, and exposure levels of the employee monitored and all other employees whose exposure the measurement is intended to represent.

WAC 296-62-07523 (Cont.)

(iii) The employer shall maintain this record for at least the duration of employment plus thirty years, in accordance with Part B, Access to records, WAC 296-62-052 through 296-62-05223.

(b) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance required by subsection (9) of this section, in accordance with WAC 296-62-052.

(ii) This record shall include:

(A) The name and Social Security number of the employee;

(B) The employer's copy of the physician's written opinion on the initial, periodic, and special examinations, including results of medical examinations and all tests, opinions, and recommendations;

(C) Any employee medical complaints related to exposure to benzene;

(D) A copy of the information provided to the physician as required by subsection (9)(f)(ii) through (v) of this section; and

(E) A copy of the employee's medical and work history related to exposure to benzene or any other hematologic toxins.

(iii) The employer shall maintain this record for at least the duration of employment plus thirty years, in accordance with Part B, Access to records, WAC 296-62-052 through 296-62-05223.

(c) Availability.

(i) The employer shall assure that all records required to be maintained by this section shall be made available upon request to the director for examination and copying.

(ii) Employee exposure monitoring records required by this subsection shall be provided upon request for examination and copying to employees, employee representatives, and the director in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217.

(iii) Employee medical records required by this subsection shall be provided upon request for examination and copying, to the subject employee, to anyone having the specific written consent of the subject employee, and to the director in accordance with WAC 296-62-052.

(d) Transfer of records.

(i) The employer shall comply with the requirements involving transfer of records set forth in WAC 296-62-05205.

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(ii) If the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the director, at least three months prior to disposal, and transmit them to the director if required by the director within that period.

(12) **Observation of monitoring.**

(a) Employee observation. The employer shall provide affected employees, or their designated representatives, an opportunity to observe the measuring or monitoring of employee exposure to benzene conducted pursuant to subsection (5) of this section.

(b) Observation procedures. When observation of the measuring or monitoring of employee exposure to benzene requires entry into areas where the use of protective clothing and equipment or respirators is required, the employer shall provide the observer with personal protective clothing and equipment or respirators required to be worn by employees working in the area, assure the use of such clothing and equipment or respirators, and require the observer to comply with all other applicable safety and health procedures.

(13) **Appendices.** The information contained in WAC 296-62-07525, Appendices A, B, C, and D is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligations.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07523, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10), § 296-62-07523, filed 05/04/99, effective 09/01/99. Statutory Authority: Chapter 49.17 RCW. 88-21-002 (Order 88-23), 296-62-07523, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07525 Appendix A substance safety data sheet--Benzene.

(1) **Substance identification.**

(a) Substance: Benzene.

(b) Permissible exposure: Except as to the use of gasoline, motor fuels, and other fuels subsequent to discharge from bulk terminals and other exemptions specified in WAC 296-62-07523 (1)(b):

(i) Airborne: The maximum time-weighted average (TWA) exposure limit is one part of benzene vapor per million parts of air (1 ppm) for an eight-hour workday and the maximum short-term exposure limit (STEL) is 5 ppm for any fifteen-minute period.

(ii) Dermal: Eye contact shall be prevented and skin contact with liquid benzene shall be limited.

(c) Appearance and odor: Benzene is a clear, colorless liquid with a pleasant, sweet odor. The odor of benzene does not provide adequate warning of its hazard.

(2) **Health hazard data.**

(a) Ways in which benzene affects your health. Benzene can affect your health if you inhale it, or if it comes in contact with your skin or eyes. Benzene is also harmful if you happen to swallow it.

WAC 296-62-07525 (Cont.)

(b) Effects of overexposure.

(i) Short-term (acute) overexposure: If you are overexposed to high concentrations of benzene, well above the levels where its odor is first recognizable, you may feel breathless, irritable, euphoric, or giddy; you may experience irritation in eyes, nose, and respiratory tract. You may develop a headache, feel dizzy, nauseated, or intoxicated. Severe exposures may lead to convulsions and loss of consciousness.

(ii) Long-term (chronic) exposure. Repeated or prolonged exposure to benzene, even at relatively low concentrations, may result in various blood disorders, ranging from anemia to leukemia, an irreversible, fatal disease. Many blood disorders associated with benzene exposure may occur without symptoms.

(3) **Protective clothing and equipment.**

(a) Respirators. Respirators are required for those operations in which engineering controls or work practice controls are not feasible to reduce exposure to the permissible level. However, where employers can document that benzene is present in the workplace less than thirty days a year, respirators may be used in lieu of engineering controls. If respirators are worn, they must have joint Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (NIOSH) seal of approval, and cartridge or canisters must be replaced before the end of their service life, or the end of the shift, whichever occurs first. If you experience difficulty breathing while wearing a respirator, you may request a positive pressure respirator from your employer. You must be thoroughly trained to use the assigned respirator, and the training will be provided by your employer.

(b) Protective clothing. You must wear appropriate protective clothing (such as boots, gloves, sleeves, aprons, etc.,) over any parts of your body that could be exposed to liquid benzene.

(c) Eye and face protection. You must wear splash-proof safety goggles if it is possible that benzene may get into your eyes. In addition, you must wear a face shield if your face could be splashed with benzene liquid.

(4) **Emergency and first aid procedures.**

(a) Eye and face exposure. If benzene is splashed in your eyes, wash it out immediately with large amounts of water. If irritation persists or vision appears to be affected see a doctor as soon as possible.

(b) Skin exposure. If benzene is spilled on your clothing or skin, remove the contaminated clothing and wash the exposed skin with large amounts of water and soap immediately. Wash contaminated clothing before you wear it again.

(c) Breathing. If you or any other person breathes in large amounts of benzene, get the exposed person to fresh air at once. Apply artificial respiration if breathing has stopped. Call for medical assistance or a doctor as soon as possible. Never enter any vessel or confined space where the benzene concentration might be high without proper safety equipment and at least one other person present who will stay outside. A life line should be used.

(d) Swallowing. If benzene has been swallowed and the patient is conscious, do not induce vomiting. Call for medical assistance or a doctor immediately.

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(5) **Medical requirements.** If you are exposed to benzene at a concentration at or above 0.5 ppm as an 8-hour time-weighted average, or have been exposed at or above 10 ppm in the past while employed by your current employer, your employer is required to provide a medical examination and history and laboratory tests within sixty days of the effective date of this standard and annually thereafter. These tests shall be provided without cost to you. In addition, if you are accidentally exposed to benzene (either by ingestion, inhalation, or skin/eye contact) under emergency conditions known or suspected to constitute toxic exposure to benzene, your employer is required to make special laboratory tests available to you.

(6) **Observation of monitoring.** Your employer is required to perform measurements that are representative of your exposure to benzene and you or your designated representative are entitled to observe the monitoring procedure. You are entitled to observe the steps taken in the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you or your representative must also be provided with, and must wear the protective clothing and equipment.

(7) **Access to records.** You or your representative are entitled to see the records of measurements of your exposure to benzene upon written request to your employer. Your medical examination records can be furnished to yourself, your physician, or designated representative upon request by you to your employer.

(8) **Precautions for safe use, handling, and storage.** Benzene liquid is highly flammable. It should be stored in tightly closed containers in a cool, well ventilated area. Benzene vapor may form explosive mixtures in air. All sources of ignition must be controlled. Use nonsparking tools when opening or closing benzene containers. Fire extinguishers, where provided, must be readily available. Know where they are located and how to operate them. Smoking is prohibited in areas where benzene is used or stored. Ask your supervisor where benzene is used in your area and for additional plant safety rules.

[Statutory Authority: Chapter 49.17 RCW. 88-21-002 (Order 88-23), 296-62-07525, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07527 Appendix B substance technical guidelines--Benzene.

(1) **Physical and chemical data.**

(a) Substance identification.

(i) Synonyms: Benzol, benzole, coal naphtha, cyclohexatriene, phene, phenyl hydride, pyrobenzol. (Benzin, petroleum benzin and Benzine do not contain benzene.)

(ii) Formula: C_6H_6 (CAS Registry Number: 71-43-2).

(b) Physical data.

(i) Boiling point (760 mm Hg); 80.1 C (176 F).

(ii) Specific gravity (water = 1): 0.879.

(iii) Vapor density (air = 1): 2.7.

(iv) Melting point: 5.5 C (42 F).

(v) Vapor pressure at 20 C (68 F): 75 mm Hg.

(vi) Solubility in water: .06%.

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(vii) Evaporation rate (ether = 1): 2.8.

(viii) Appearance and odor: Clear, colorless liquid with a distinctive sweet odor.

(2) **Fire, explosion, and reactivity hazard data.**

(a) Fire.

(i) Flash point (closed cup): -11 C (12 F).

(ii) Autoignition temperature: 580 C (1076 F).

(iii) Flammable limits in Air. % by volume: Lower: 1.3%, Upper: 7.5%.

(iv) Extinguishing media: Carbon dioxide, dry chemical, or foam.

(v) Special fire-fighting procedures: Do not use solid stream of water, since stream will scatter and spread fire. Fine water spray can be used to keep fire-exposed containers cool.

(vi) Unusual fire and explosion hazards: Benzene is a flammable liquid. Its vapors can form explosive mixtures. All ignition sources must be controlled when benzene is used, handled, or stored. Where liquid or vapor may be released, such areas shall be considered as hazardous locations. Benzene vapors are heavier than air; thus the vapors may travel along the ground and be ignited by open flames or sparks at locations remote from the site at which benzene is handled.

(vii) Benzene is classified as a 1 B flammable liquid for the purpose of conforming to the requirements of WAC 296-24-330. A concentration exceeding 3,250 ppm is considered a potential fire explosion hazard. Locations where benzene may be present in quantities sufficient to produce explosive or ignitable mixtures are considered Class I Group D for the purposes of conforming to the requirements of WAC 296-24-95613.

(b) Reactivity.

(i) Conditions contributing to instability: Heat.

(ii) Incompatibility: Heat and oxidizing materials.

(iii) Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide).

(3) **Spill and leak procedures.**

(a) Steps to be taken if the material is released or spilled. As much benzene as possible should be absorbed with suitable materials, such as dry sand or earth; benzene remaining must be flushed with large amounts of water. Do not flush benzene into a confined space, such as a sewer, because of explosion danger. Remove all ignition sources. Ventilate enclosed places.

(b) Waste disposal method. Disposal methods must conform to other jurisdictional regulations. If allowed, benzene may be disposed of:

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(i) By absorbing it in dry sand or earth and disposing in a sanitary landfill;

(ii) If small quantities, by removing it to a safe location from buildings or other combustible sources, pouring it in dry sand or earth and cautiously igniting it; and

(iii) If large quantities, by atomizing it in a suitable combustion chamber.

(4) **Miscellaneous precautions.**

(a) High exposure to benzene can occur when transferring the liquid from one container to another. Such operations should be well ventilated and good work practices must be established to avoid spills.

(b) Use nonsparking tools to open benzene containers which are effectively grounded and bonded prior to opening and pouring.

(c) Employers must advise employees of all plant areas and operations where exposure to benzene could occur. Common operations in which high exposures to benzene may be encountered are: The primary production and utilization of benzene, and transfer of benzene.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20), § 296-62-07527, filed 06/05/02, effective 08/01/02. Statutory Authority: Chapter 49.17 RCW. 88-21-002 (Order 88-23), 296-62-07527, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07529 Appendix C medical surveillance guidelines for benzene.

(1) **Route of entry. Inhalation; skin absorption.**

(2) **Toxicology.** Benzene is primarily an inhalation hazard. Systemic absorption may cause depression of the hematopoietic system, pancytopenia, aplastic anemia, and leukemia. Inhalation of high concentrations can affect central nervous system function. Aspiration of small amounts of liquid benzene immediately causes pulmonary edema and hemorrhage of pulmonary tissue. There is some absorption through the skin. Absorption may be more rapid in the case of abraded skin, and benzene may be more readily absorbed if it is present in a mixture or as a contaminant in solvents which are readily absorbed. The defatting action of benzene may produce primary irritation due to repeated or prolonged contact with the skin. High concentrations are irritating to the eyes and the mucous membranes of the nose, and respiratory tract.

(3) **Signs and symptoms.** Direct skin contact with benzene may cause erythema. Repeated or prolonged contact may result in drying, scaling dermatitis, or development of secondary skin infections. In addition, there is benzene absorption through the skin. Local effects of benzene vapor or liquid on the eye are slight. Only at very high concentrations is there any smarting sensation in the eye. Inhalation of high concentrations of benzene may have an initial stimulatory effect on the central nervous system characterized by exhilaration, nervous excitation, and/or giddiness, followed by a period of depression, drowsiness, or fatigue. A sensation of tightness in the chest accompanied by breathlessness may occur and ultimately the victim may lose consciousness. Tremors, convulsions, and death may follow from respiratory paralysis or circulatory collapse in a few minutes to several hours following severe exposures.

The detrimental effect on the blood-forming system of prolonged exposure to small quantities of benzene vapor is of extreme importance. The hematopoietic system is the chief target for benzene's toxic effects which are manifested by alterations in the levels of formed elements in the peripheral blood. These effects have occurred at concentrations of benzene which may not cause irritation of mucous membranes, or any unpleasant sensory effects. Early signs and symptoms of benzene morbidity are varied, often not readily noticed and nonspecific. Subjective complaints of headache, dizziness, and loss of appetite may precede or

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follow clinical signs. Rapid pulse and low blood pressure, in addition to a physical appearance of anemia, may accompany a subjective complaint of shortness of breath and excessive tiredness. Bleeding from the nose, gums, or mucous membranes, and the development of purpuric spots (small bruises) may occur as the condition progresses. Clinical evidence of leukopenia, anemia, and thrombocytopenia, singly or in combination, has been frequently reported among the first signs.

Bone marrow may appear normal, aplastic, or hyperplastic, and may not, in all situations, correlate with peripheral blood forming tissues. Because of variations in the susceptibility to benzene morbidity, there is no "typical" blood picture. The onset of effects of prolonged benzene exposure may be delayed for many months or years after the actual exposure has ceased and identification or correlation with benzene exposure must be sought out in the occupational history.

(4) **Treatment of acute toxic effects.** Remove from exposure immediately. Make sure you are adequately protected and do not risk being overcome by fumes. Give oxygen or artificial resuscitation if indicated. Flush eyes, wash skin if contaminated and remove all contaminated clothing. Symptoms of intoxication may persist following severe exposures. Recovery from mild exposures is usually rapid and complete.

(5) **Surveillance and preventive considerations.**

(a) General. The principal effects of benzene exposure which form the basis for this regulation are pathological changes in the hematopoietic system, reflected by changes in the peripheral blood and manifesting clinically as pancytopenia, aplastic anemia, and leukemia. Consequently, the medical surveillance program is designed to observe, on a regular basis, blood indices for early signs of these effects, and although early signs of leukemia are not usually available, emerging diagnostic technology and innovative regimes make consistent surveillance for leukemia, as well as other hematopoietic effects, essential.

Initial examinations are to be provided within sixty days of the effective date of this standard, or at the time of initial assignment, and periodic examinations annually thereafter.

There are special provisions for medical tests in the event of hematologic abnormalities or for emergency situations.

The blood values which require referral to a hematologist or internist are noted in (b)(i) of this subsection. The standard specifies that blood abnormalities that persist must be referred "unless the physician has good reason to believe such referral is unnecessary" ((b)(i) of this subsection). Examples of conditions that could make a referral unnecessary despite abnormal blood limits are iron or folate deficiency, menorrhagia, or blood loss due to some unrelated medical abnormality.

Symptoms and signs of benzene toxicity can be nonspecific. Only a detailed history and appropriate investigative procedure will enable a physician to rule out or confirm conditions that place the employee at increased risk. To assist the examining physician with regard to which laboratory tests are necessary and when to refer an employee to the specialist, OSHA has established the following guidelines.

(b) Hematology guidelines. A minimum battery of tests is to be performed by strictly standardized methods.

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(i) Red cell, white cell, platelet counts, white blood cell differential, hematocrit and red cell indices must be performed by an accredited laboratory. The normal ranges for the red cell and white cell counts are influenced by altitude, race, and sex, and therefore should be determined by the accredited laboratory in the specific area where the tests are performed.

Either a decline from an absolute normal or an individual's baseline to a subnormal value or a rise to a supra-normal value, are indicative of potential toxicity, particularly if all blood parameters decline. The normal total white blood count is approximately 7,200/mm^3 plus or minus 3,000. For cigarette smokers the white count may be higher and the upper range may be 2,000 cells higher than normal for the laboratory. In addition, infection, allergies and some drugs may raise the white cell count. The normal platelet count is approximately 250,000 with a range of 140,000 to 400,000. Counts outside this range should be regarded as possible evidence of benzene toxicity.

Certain abnormalities found through routine screening are of greater significance in the benzene-exposed worker and require prompt consultation with a specialist, namely:

(A) Thrombocytopenia.

(B) A trend of decreasing white cell, red cell, or platelet indices in an individual over time is more worrisome than an isolated abnormal finding at one test time. The importance of trend highlights the need to compare an individual's test results to baseline and/or previous periodic tests.

(C) A constellation or pattern of abnormalities in the different blood indices is of more significance than a single abnormality. A low white count not associated with any abnormalities in other cell indices may be a normal statistical variation, whereas if the low white count is accompanied by decreases in the platelet and/or red cell indices, such a pattern is more likely to be associated with benzene toxicity and merits thorough investigation.

Anemia, leukopenia, macrocytosis or an abnormal differential white blood cell count should alert the physician to further investigate and/or refer the patient if repeat tests confirm the abnormalities. If routine screening detects an abnormality, follow-up tests which may be helpful in establishing the etiology of the abnormality are the peripheral blood smear and the reticulocyte count.

The extreme range of normal for reticulocytes is 0.4 to 2.5 percent of the red cells, the usual range being 0.5 to 1.2 percent of the red cells, but the typical value is in the range of 0.8 to 1.0 percent. A decline in reticulocytes to levels of less than 0.4 percent is to be regarded as possible evidence (unless another specific cause is found) of benzene toxicity requiring accelerated surveillance. An increase in reticulocyte levels to about 2.5 percent may also be consistent with (but is not as characteristic of) benzene toxicity.

(ii) An important diagnostic test is a careful examination of the peripheral blood smear. As with reticulocyte count the smear should be with fresh uncoagulated blood obtained from a needle tip following venipuncture or from a drop of earlobe blood (capillary blood). If necessary, the smear may, under certain limited conditions, be made from a blood sample

anticoagulated with EDTA (but never with oxalate or heparin). When the smear is to be prepared from a specimen of venous blood which has been collected by a commercial Vacutainer type tube containing neutral EDTA, the smear should be made as soon as possible after the venesection. A delay of up to twelve hours is permissible between the drawing of the blood specimen into EDTA and the preparation of the smear if the blood is stored at refrigerator (not freezing) temperature.

(iii) The minimum mandatory observations to be made from the smear are:

(A) The differential white blood cell count;

(B) Description of abnormalities in the appearance of red cells; and

(C) Description of any abnormalities in the platelets.

(D) A careful search must be made throughout of every blood smear for immature white cells such as band forms (in more than normal proportion, i.e., over ten percent of the total differential count), any number of metamyelocytes, myelocytes, or myeloblasts. Any nucleate or multinucleated red blood cells should be reported. Large "giant" platelets or fragments of megakaryocytes must be recognized.

An increase in the proportion of band forms among the neutrophilic granulocytes is an abnormality deserving special mention, for it may represent a change which should be considered as an early warning of benzene toxicity in the absence of other causative factors (most commonly infection). Likewise, the appearance of metamyelocytes, in the absence of another probable cause, is to be considered a possible indication of benzene-induced toxicity.

An upward trend in the number of basophils, which normally do not exceed about 2.0 percent of the total white cells, is to be regarded as possible evidence of benzene toxicity. A rise in the eosinophil count is less specific but also may be suspicious of toxicity if it rises above 6.0 percent of the total white count.

The normal range of monocytes is from 2.0 to 8.0 percent of the total white count with an average of about 5.0 percent. About twenty percent of individuals reported to have mild but persisting abnormalities caused by exposure to benzene show a persistent monocytosis. The findings of a monocyte count which persists at more than ten to twelve percent of the normal white cell count (when the total count is normal) or persistence of an absolute monocyte count in excess of $800/mm^3$ should be regarded as a possible sign of benzene-induced toxicity.

A less frequent but more serious indication of benzene toxicity is the finding in the peripheral blood of the so-called "pseudo" (or acquired) Pelger-Huet anomaly. In this anomaly many, or sometimes the majority, of the neutrophilic granulocytes possess two round nuclear segments-less often one or three round segments-rather than three normally elongated segments. When this anomaly is not hereditary, it is often but not invariably predictive of subsequent leukemia. However, only about two percent of patients who ultimately develop acute myelogenous leukemia show the acquired Pelger-Huet anomaly. Other tests that can be administered to investigate blood abnormalities are discussed below; however, such procedures should be undertaken by the hematologist.

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An uncommon sign, which cannot be detected from the smear, but can be elicited by a "sucrose water test" of peripheral blood, is transient paroxysmal nocturnal hemoglobinuria (PNH), which may first occur insidiously during a period of established aplastic anemia, and may be followed within one to a few years by the appearance of rapidly fatal acute myelogenous leukemia. Clinical detection of PNH, which occurs in only one or two percent of those destined to have acute myelogenous leukemia, may be difficult; if the "sucrose water test" is positive, the somewhat more definitive Ham test, also known as the acid-serum hemolysis test, may provide confirmation.

(E) Individuals documented to have developed acute myelogenous leukemia years after initial exposure to benzene may have progressed through a preliminary phase of hematologic abnormality. In some instances pancytopenia (i.e., a lowering in the counts of all circulating blood cells of bone marrow origin, but not to the extent implied by the term "aplastic anemia") preceded leukemia for many years. Depression of a single blood cell type or platelets may represent a harbinger of aplasia or leukemia. The finding of two or more cytopenias, or pancytopenia in a benzene-exposed individual, must be regarded as highly suspicious of more advanced although still reversible, toxicity. "Pancytopenia" coupled with the appearance of immature cells (myelocytes, myeloblasts, erythroblasts, etc.), with abnormal cells (pseudo Pelger-Huet anomaly, atypical nuclear heterochromatin, etc.), or unexplained elevations of white blood cells must be regarded as evidence of benzene overexposure unless proved otherwise.

Many severely aplastic patients manifested the ominous finding of five to ten percent myeloblasts in the marrow, occasional myeloblasts and myelocytes in the blood and twenty to thirty monocytes. It is evident that isolated cytopenias, pancytopenias, and even aplastic anemias induced by benzene may be reversible and complete recovery has been reported on cessation of exposure. However, since any of these abnormalities is serious, the employee must immediately be removed from any possible exposure to benzene vapor. Certain tests may substantiate the employee's prospects for progression or regression. One such test would be an examination of the bone marrow, but the decision to perform a bone marrow aspiration or needle biopsy is made by the hematologist.

The findings of basophilic stippling in circulating red blood cells (usually found in one to five percent of red cells following marrow injury), and detection in the bone marrow of what are termed "ringed sideroblasts" must be taken seriously, as they have been noted in recent years to be premonitory signs of subsequent leukemia.

Recently peroxidase-staining of circulating or marrow neutrophil granulocytes, employing benzidine dihydrochloride, have revealed the disappearance of, or diminution in, peroxidase in a sizable proportion of the granulocytes, and this has been reported as an early sign of leukemia. However, relatively few patients have been studied to date. Granulocyte granules are normally strongly peroxidase positive. A steady decline in leukocyte alkaline phosphatase has also been reported as suggestive of early acute leukemia. Exposure to benzene may cause an early rise in serum iron, often but not always associated with a fall in the reticulocyte count. Thus, serial measurements of serum iron levels may provide a means of determining whether or not there is a trend representing sustained suppression of erythropoiesis.

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Measurement of serum iron, determination of peroxidase and of alkaline phosphatase activity in peripheral granulocytes can be performed in most pathology laboratories. Peroxidase and alkaline phosphatase staining are usually undertaken when the index of suspicion for leukemia is high.

[Statutory Authority: Chapter 49.17 RCW. 88-21-002 (Order 88-23), 296-62-07529, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07531 Appendix D sampling and analytical methods for benzene monitoring and measurement procedures. Measurements taken for the purpose of determining employee exposure to benzene are best taken so that the representative average eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples. Short-time interval samples (or grab samples) may also be used to determine average exposure level if a minimum of five measurements are taken in a random manner over the eight-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random samples taken on one work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). Sampling and analysis must be performed with procedures meeting the requirements of the standard.

There are a number of methods available for monitoring employee exposures to benzene. The sampling and analysis may be performed by collection of the benzene vapor on charcoal adsorption tubes, with subsequent chemical analysis by gas chromatography. Sampling and analysis may also be performed by portable direct reading instruments, real-time continuous monitoring systems, passive dosimeters or other suitable methods. The employer has the obligation of selecting a monitoring method which meets the accuracy and precision requirements of the standard under his unique field conditions. The standard requires that the method of monitoring must have an accuracy, to a ninety-five percent confidence level, of not less than plus or minus twenty-five percent for concentrations of benzene greater than or equal to 0.5 ppm.

The WISHA laboratory uses NIOSH Method 1500 for evaluation of benzene air concentrations.

(1) **WISHA method HYDCB for air samples.**

Analyte: Benzene.

Matrix: Air.

Procedure: Adsorption on charcoal, desorption with carbon disulfide, analysis by GC.

Detection limit: 0.04 ppm.

Recommended air volume and sampling rate: 10L at 0.05 to 0.2 L/min.

(a) Principle of the method.

(i) A known volume of air is drawn through a charcoal tube to trap the organic vapors present.

(ii) The charcoal in the tube is transferred to a small, stoppered vial, and the analyte is desorbed with carbon disulfide.

(iii) An aliquot of the desorbed sample is injected into a gas chromatograph.

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(iv) The area of the resulting peak is determined and compared with areas obtained from standards.

(b) Advantages and disadvantages of the method.

(i) The sampling device is small, portable, and involves no liquids. Interferences are minimal, and most of those which do occur can be eliminated by altering chromatographic conditions. The samples are analyzed by means of a quick, instrumental method.

(ii) The amount of sample which can be taken is limited by the number of milligrams that the tube will hold before overloading. When the sample value obtained for the backup section of the charcoal tube exceeds twenty-five percent of that found on the front section, the possibility of sample loss exists.

(c) Apparatus.

(i) A calibrated personal sampling pump whose flow can be determined within ±5 percent at the recommended flow rate.

(ii) Charcoal tubes: Glass with both ends flame sealed, 7 cm long with a 6-mm O.D. and a 4-mm I.D., containing two sections of 20/40 mesh activated charcoal separated by a 2-mm portion of urethane foam. The activated charcoal is prepared from coconut shells and is obtained commercially. The adsorbing section contains 100 mg of charcoal, the back-up section 50 mg. A 3-mm portion of urethane foam is placed between the outlet end of the tube and the back-up section. A plug of silanized glass wool is placed in front of the adsorbing section. The pressure drop across the tube must be less than one inch of mercury at a flow rate of one liter per minute.

(iii) Gas chromatograph equipped with a flame ionization detector.

(iv) Column (10-ft 1/8-in stainless steel) packed with 80/100 Supelcoport coated with twenty percent SP 2100, 0.1 percent CW 1500.

(v) An electronic integrator or some other suitable method for measuring peak area.

(vi) Two-milliliter sample vials with Teflon-lined caps.

(vii) Microliter syringes: 10-microliter 10-uL syringe, and other convenient sizes for making standards, 1-uL syringe for sample injections.

(viii) Pipets: 1.0 mL delivery pipets.

(ix) Volumetric flasks: Convenient sizes for making standard solutions.

(d) Reagents.

(i) Chromatographic quality carbon disulfide (CS2). Most commercially available carbon disulfide contains a trace of benzene which must be removed. It can be removed with the following procedure:

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Heat under reflux for two to three hours, 500 mL of carbon disulfide, 10 mL concentrated sulfuric acid, and five drops of concentrated nitric acid. The benzene is converted to nitrobenzene. The carbon disulfide layer is removed, dried with anhydrous sodium sulfate, and distilled. The recovered carbon disulfide should be benzene free. (It has recently been determined that benzene can also be removed by passing the carbon disulfide through 13x molecular sieve.)

(ii) Benzene, reagent grade.

(iii) p-Cymene, reagent grade, (internal standard).

(iv) Desorbing reagent. The desorbing reagent is prepared by adding 0.05 mL of p-Cymene per milliliter of carbon disulfide. (The internal standard offers a convenient means correcting analytical response for slight inconsistencies in the size of sample injections. If the external standard technique is preferred, the internal standard can be eliminated.)

(v) Purified GC grade helium, hydrogen, and air.

(e) Procedure.

(i) Cleaning of equipment. All glassware used for the laboratory analysis should be properly cleaned and free of organics which could interfere in the analysis.

(ii) Calibration of personal pumps. Each pump must be calibrated with a representative charcoal tube in the line.

(iii) Collection and shipping of samples.

(A) Immediately before sampling, break the ends of the tube to provide an opening at least one-half the internal diameter of the tube (2 mm).

(B) The smaller section of the charcoal is used as the backup and should be placed nearest the sampling pump.

(C) The charcoal tube should be placed in a vertical position during sampling to minimize channeling through the charcoal.

(D) Air being sampled should not be passed through any hose or tubing before entering the charcoal tube.

(E) A sample size of ten liters is recommended. Sample at a flow rate of approximately 0.05 to 0.2 liters per minute. The flow rate should be known with an accuracy of at least ±5 percent.

(F) The charcoal tubes should be capped with the supplied plastic caps immediately after sampling.

(G) Submit at least one blank tube (a charcoal tube subjected to the same handling procedures, without having any air drawn through it) with each set of samples. Take necessary shipping and packing precautions to minimize breakage of samples.

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(iv) Analysis of samples.

(A) Preparation of samples. In preparation for analysis, each charcoal tube is scored with a file in front of the first section of charcoal and broken open. The glass wool is removed and discarded. The charcoal in the first (larger) section is transferred to a 2-ml vial. The separating section of foam is removed and discarded; the second section is transferred to another capped vial. These two sections are analyzed separately.

(B) Desorption of samples. Prior to analysis, 1.0 mL of desorbing solution is pipetted into each sample container. The desorbing solution consists of 0.05 uL internal standard per mL of carbon disulfide. The sample vials are capped as soon as the solvent is added. Desorption should be done for thirty minutes with occasional shaking.

(C) GC conditions. Typical operating conditions for the gas chromatograph are:

(I) 30 mL/min (60 psig) helium carrier gas flow.

(II) 30 mL/min (40 psig) hydrogen gas flow to detector.

(III) 240 mL/min (40 psig) air flow to detector.

(IV) 150°C injector temperature.

(V) 250°C detector temperature.

(VI) 100°C column temperature.

(D) Injection size. 1 µL.

(E) Measurement of area. The peak areas are measured by an electronic integrator or some other suitable form of area measurement.

(F) An internal standard procedure is used. The integrator is calibrated to report results in ppm for a ten liter air sample after correction for desorption efficiency.

(v) Determination of desorption efficiency.

(A) Importance of determination. The desorption efficiency of a particular compound can vary from one laboratory to another and from one lot of chemical to another. Thus, it is necessary to determine, at least once, the percentage of the specific compound that is removed in the desorption process, provided the same batch of charcoal is used.

(B) Procedure for determining desorption efficiency. The reference portion of the charcoal tube is removed. To the remaining portion, amounts representing 0.5X, 1X, and 2X and (X represents target concentration) based on a 10 L air sample are injected into several tubes at each level. Dilutions of benzene with carbon disulfide are made to allow injection of measurable quantities. These

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tubes are then allowed to equilibrate at least overnight. Following equilibration they are analyzed following the same procedure as the samples. Desorption efficiency is determined by dividing the amount of benzene found by amount spiked on the tube.

(f) Calibration and standards. A series of standards varying in concentration over the range of interest is prepared and analyzed under the same GC conditions that will be used on the samples. A calibration curve is prepared by plotting concentration (mg/mL) versus peak area.

(g) Calculations. Benzene air concentration can be calculated from the following equation:

$mg/m^3 = (A)(B)/(C)(D)$

Where: A = µg/mL benzene, obtained from the calibration curve

B = desorption volume (1 mL)

C = Liters of air sampled

D = desorption efficiency

The concentration in mg/m^3 can be converted to ppm (at 25° C and 760 mm) with the following equation:

$ppm = (mg/m^3)(24.46)/(78.11)$

Where: 24.46 = molar volume of an ideal gas 25° C and 760 mm

78.11 = molecular weight of benzene

(h) Backup data.

(i) Detection limit-air samples.

The detection limit for the analytical procedure is 1.28 mg with a coefficient of 0.04 ppm for a 10 L air sample. This amount provided a chromatographic peak that could be identifiable in the presence of possible interferences. The detection limit data were obtained by making 1 µL injections of a 1.283 µg/mL standard.

TABLE 1

Injection	Area Count	
1	655.4	
2	617.5	
3	662.0	$\bar{X}$ = 640.2
4	641.1	SD = 14.9
5	636.4	CV = 0.023
6	629.2	

(ii) Pooled coefficient of variation-Air Samples. The pooled coefficient of variation for the analytical procedure was determined by 1 uL replicate injections of analytical standards. The standards were 16.04, 32.08, and 64.16 µg/mL, which are equivalent to 0.5, 1.0, and 2.0 ppm for a 10 L air sample respectively.

TABLE 2

	Area Count		
Injection	**0.5 ppm**	**1.0 ppm**	**2.0 ppm**
1	3996.5	8130.2	16481
2	4059.4	8235.6	16493
3	4052.0	8307.9	16535
4	4027.2	8263.2	16609
5	4046.3	8291.1	16552
6	4137.9	8288.8	16618
$\bar{X}$ =	4053.3	8254.0	16548.3
SD =	47.2	62.5	57.1
CV =	0.0116	0.0076	0.0034
CV =			

(iii) Storage data-air samples.

Samples were generated at 1.03 ppm benzene at eighty percent relative humidity, 22° C, and 643 mm. All samples were taken for fifty minutes at 0.2 L/min. Six samples were analyzed immediately and the rest of the samples were divided into two groups by fifteen samples each. One group was stored at refrigerated temperature of –25° C, and the other group was stored at ambient temperature (approximately 23° C). These samples were analyzed over a period of fifteen days. The results are tabulated below.

TABLE 3

Day analyzed	**Refrigerated**			**Ambient**		
0	97.4	98.7	98.9	97.4	98.7	98.9
0	97.1	100.5	100.9*	97.1	100.6	100.9
2	95.8	96.4	95.4	95.4	96.6	96.9
5	93.9	93.7	92.4	92.4	94.3	94.1
9	93.6	95.5	94.6	95.2	95.6	96.6
13	94.3	95.3	93.7	91.0	95.0	94.6
15	96.6	95.8	94.2	92.9	96.3	95.9

(iv) Desorption data.

Samples were prepared by injecting liquid benzene onto the A section of charcoal tubes. Samples were prepared that would be equivalent to 0.5, 1.0, and 2.0 ppm for a 10 L air sample.

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TABLE 4

Sample	0.5 ppm	1.0 ppm	2.0 ppm
1	99.4	98.8	99.5
2	99.5	98.7	99.7
3	99.2	98.6	99.2
4	99.4	99.1	100.0
5	99.2	99.0	99.7
6	99.8	99.1	99.9
$\bar{X}$ =	99.4	98.9	99.8
SD =	.22	0.21	0.18
CV =	0.0022	0.0021	0.0018
$\bar{X}$ = 99.4			

(v) Carbon disulfide.

Carbon disulfide from a number of sources was analyzed for benzene contamination. The results are given in the following table. The benzene contaminant can be removed with the procedures given in (d)(i) of this subsection.

TABLE 5

SAMPLE	µG Benzene/mL	ppm equivalent (for 10 l air sample
Aldrich Lot 83017	4.20	0.13
Baker Lot 720364	1.0†	0.03
Baker Lot 822351	1.0†	0.03
Malinkrodt Lot WEMP	1.74	0.05
Malinkrodt Lot WHGA	5.65	0.18
Treated CS^2	2.90	0.09

(2) **WISHA laboratory method for bulk samples.**

Analyte: Benzene.

Matrix: Bulk samples.

Procedure: Bulk samples are analyzed directly by high performance liquid chromatography (HPLC) or by capillary gas chromatography. See laboratory manual for GC procedure.

Detection limits: 0.01% by volume.

(a) Principle of the method.

(i) An aliquot of the bulk sample to be analyzed is injected into a liquid chromatograph or gas chromatograph.

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(ii) The peak area for benzene is determined and compared to areas obtained from standards.

(b) Advantages and disadvantages of the method.

(i) The analytical procedure is quick, sensitive, and reproducible.

(ii) Reanalysis of samples is possible.

(iii) Interferences can be circumvented by proper selection of HPLC parameters or GC parameters.

(iv) Samples must be free of any particulates that may clog the capillary tubing in the liquid chromatograph. This may require distilling the sample or clarifying with a clarification kit.

(c) Apparatus.

(i) Liquid chromatograph equipped with a UV detector or capillary gas chromatograph with FID detector.

(ii) HPLC column that will separate benzene from other components in the bulk sample being analyzed. The column used for validation studies was a Waters uBondapack C18, 30 cm x 3.9 mm.

(iii) A clarification kit to remove any particulates in the bulk if necessary.

(iv) A micro-distillation apparatus to distill any samples if necessary.

(v) An electronic integrator or some other suitable method of measuring peak areas.

(vi) Microliter syringes-10 µL syringe and other convenient sizes for making standards. 10 µL syringe for sample injections.

(vii) Volumetric flasks, 5 mL and other convenient sizes for preparing standards and making dilutions.

(d) Reagents.

(i) Benzene, reagent grade.

(ii) HPLC grade water, methyl alcohol, and isopropyl alcohol.

(e) Collection and shipment of samples.

(i) Samples should be transported in glass containers with Teflon-lined caps.

(ii) Samples should not be put in the same container used for air samples.

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(f) Analysis of samples.

(i) Sample preparation.

If necessary, the samples are distilled or clarified. Samples are analyzed undiluted. If the benzene concentration is out of the working range, suitable dilutions are made with isopropyl alcohol.

(ii) HPLC conditions.

The typical operating conditions for the high performance liquid chromatograph are:

(A) Mobile phase-Methyl alcohol/water, 50/50.

(B) Analytical wavelength-254 nm.

(C) Injection size-10 µL.

(iii) Measurement of peak area and calibration.

Peak areas are measured by an integrator or other suitable means. The integrator is calibrated to report results % in benzene by volume.

(g) Calculations.

Since the integrator is programmed to report results in % benzene by volume in an undiluted sample, the following equation is used:

% Benzene by Volume = A x B

Where: A = % by volume on report

B = Dilution Factor

(B = 1 for undiluted sample)

(h) Backup data.

(i) Detection limit-bulk samples.

The detection limit for the analytical procedure for bulk samples is 0.88 µg, with a coefficient or variation of 0.019 at this level. This amount provided a chromatographic peak that could be identifiable in the presence of possible interferences. The detection limit data were obtained by making 10 µL injections of a 0.10% by volume standard.

TABLE 6

1	45386	
2	44214	
3	43822	$\bar{X}$ = 44040.1
4	44062	SD = 852.5
6	42724	CV = 0.019

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(ii) Pooled coefficient of variation-bulk samples.

The pooled coefficient of variation for analytical procedure was determined by 50 µL replicate injections of analytical standards. The standards were 0.01, 0.02, 0.04, 0.10, 1.0, and 2.0% benzene by volume.

TABLE 7

Injection No.	0.01	0.02	0.04	0.10	1.0	2.0
1	45386	84737	166097	448497	4395380	9339150
2	44241	84300	170832	441299	4590800	9484900
3	43833	83835	164160	443719	4593200	9557580
4	44062	84381	164445	444842	4642350	9677060
5	44006	83012	168398	442564	4646430	9766240
6	42724	81957	173002	443975	4646260	------
_						
X	44040.1	83703.6	167872	444149	4585767	9564986
SD =	852.5	1042.2	3589.8	2459.1	96839.3	166233
CV =	0.0194	0.0125	0.0213	0.0055	0.0211	0.0174
____						
CV =	0.017					

[Statutory Authority: Chapter 49.17 RCW. 90-09-026 (Order 90-01), 296-62-07531, filed 4/10/90, effective 5/25/90; 89-11-035 (Order 89-03), 296-62-07531, filed 5/15/89, effective 6/30/89; 88-21-002 (Order 88-23), 296-62-07531, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07540 Formaldehyde.

(1) **Scope and application.** This standard applies to all occupational exposures to formaldehyde, i.e., from formaldehyde gas, its solutions, and materials that release formaldehyde.

(2) **Definitions.** For purposes of this standard, the following definitions shall apply:

(a) **"Action level"** means a concentration of 0.5 part formaldehyde per million parts of air (0.5 ppm) calculated as an 8-hour time-weighted average (TWA) concentration.

(b) **"Approved"** means approved by the director of the department of labor and industries or his/her authorized representative: Provided, however, That should a provision of this chapter state that approval by an agency or organization other than the department of labor and industries is required, such as Underwriters' Laboratories or the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health, the provision of WAC 296-800-370 shall apply.

(c) **"Authorized person"** means any person required by work duties to be present in regulated work areas, or authorized to do so by the employer, by this section of the standard, or by the WISHA Act.

(d) **"Director"** means the director of the department of labor and industries, or his/her designated representative.

(e) **"Emergency"** is any occurrence, such as but not limited to equipment failure, rupture of containers, or failure of control equipment that results in an uncontrolled release of a significant amount of formaldehyde.

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(f) **"Employee exposure"** means the exposure to airborne formaldehyde which would occur without corrections for protection provided by any respirator that is in use.

(g) **"Formaldehyde"** means the chemical substance, HCHO, Chemical Abstracts Service Registry No. 50-00-0.

(3) **Permissible exposure limit (PEL).**

(a) TWA: The employer shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds 0.75 part formaldehyde per million parts of air as an 8-hour TWA.

(b) Short term exposure limit (STEL): The employer shall assure that no employee is exposed to an airborne concentration of formaldehyde which exceeds two parts formaldehyde per million parts of air (2 ppm) as a fifteen-minute STEL.

(4) **Exposure monitoring.**

(a) General.

(i) Each employer who has a workplace covered by this standard shall monitor employees to determine their exposure to formaldehyde.

(ii) Exception. Where the employer documents, using objective data, that the presence of formaldehyde or formaldehyde-releasing products in the workplace cannot result in airborne concentrations of formaldehyde that would cause any employee to be exposed at or above the action level or the STEL under foreseeable conditions of use, the employer will not be required to measure employee exposure to formaldehyde.

(iii) When an employee's exposure is determined from representative sampling, the measurements used shall be representative of the employee's full shift or short-term exposure to formaldehyde, as appropriate.

(iv) Representative samples for each job classification in each work area shall be taken for each shift unless the employer can document with objective data that exposure levels for a given job classification are equivalent for different workshifts.

(b) Initial monitoring. The employer shall identify all employees who may be exposed at or above the action level or at or above the STEL and accurately determine the exposure of each employee so identified.

(i) Unless the employer chooses to measure the exposure of each employee potentially exposed to formaldehyde, the employer shall develop a representative sampling strategy and measure sufficient exposures within each job classification for each workshift to correctly characterize and not underestimate the exposure of any employee within each exposure group.

(ii) The initial monitoring process shall be repeated each time there is a change in production, equipment, process, personnel, or control measures which may result in new or additional exposure to formaldehyde.

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(iii) If the employer receives reports or signs or symptoms of respiratory or dermal conditions associated with formaldehyde exposure, the employer shall promptly monitor the affected employee's exposure.

(c) Periodic monitoring.

(i) The employer shall periodically measure and accurately determine exposure to formaldehyde for employees shown by the initial monitoring to be exposed at or above the action level or at or above the STEL.

(ii) If the last monitoring results reveal employee exposure at or above the action level, the employer shall repeat monitoring of the employees at least every six months.

(iii) If the last monitoring results reveal employee exposure at or above the STEL, the employer shall repeat monitoring of the employees at least once a year under worst conditions.

(d) Termination of monitoring. The employer may discontinue periodic monitoring for employees if results from two consecutive sampling periods taken at least seven days apart show that employee exposure is below the action level and the STEL. The results must be statistically representative and consistent with the employer's knowledge of the job and work operation.

(e) Accuracy of monitoring. Monitoring shall be accurate, at the ninety-five percent confidence level, to within plus or minus twenty-five percent for airborne concentrations of formaldehyde at the TWA and the STEL and to within plus or minus thirty-five percent for airborne concentrations of formaldehyde at the action level.

(f) Employee notification of monitoring results. Within fifteen days of receiving the results of exposure monitoring conducted under this standard, the employer shall notify the affected employees of these results. Notification shall be in writing, either by distributing copies of the results to the employees or by posting the results. If the employee exposure is over either PEL, the employer shall develop and implement a written plan to reduce employee exposure to or below both PELs, and give written notice to employees. The written notice shall contain a description of the corrective action being taken by the employer to decrease exposure.

(g) Observation of monitoring.

(i) The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to formaldehyde required by this standard.

(ii) When observation of the monitoring of employee exposure to formaldehyde requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the clothing and equipment to the observer, require the observer to use such clothing and equipment, and assure that the observer complies with all other applicable safety and health procedures.

(5) **Regulated areas.**

(a) The employer shall establish regulated areas where the concentration of airborne formaldehyde exceeds either the TWA or the STEL and post all entrances and accessways with signs bearing the following information:

WAC 296-62-07540 (Cont.)

DANGER
FORMALDEHYDE
IRRITANT AND POTENTIAL CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

(b) The employer shall limit access to regulated areas to authorized persons who have been trained to recognize the hazards of formaldehyde.

(c) An employer at a multi-employer worksite who establishes a regulated area shall communicate the access restrictions and locations of these areas to other employers with work operations at that worksite.

(6) **Methods of compliance.**

(a) Engineering controls and work practices. The employer shall institute engineering and work practice controls to reduce and maintain employee exposures to formaldehyde at or below the TWA and the STEL.

(b) Exception. Whenever the employer has established that feasible engineering and work practice controls cannot reduce employee exposure to or below either of the PELs, the employer shall apply these controls to reduce employee exposures to the extent feasible and shall supplement them with respirators which satisfy this standard.

(7) **Respiratory protection.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering and work-practice controls;

(ii) Work operations, such as maintenance and repair activities or vessel cleaning, for which the employer establishes that engineering and work-practice controls are not feasible;

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce exposure to or below the PELs;

(iv) Emergencies.

(b) Respirator program.

(i) The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1), 296-62-07131 (4) and 296-62-07150 through 296-62-07156).

(ii) If air-purifying chemical-cartridge respirators are used, the employer must:

(A) Replace the cartridge after three hours of use or at the end of the workshift, whichever occurs first, unless the cartridge contains a NIOSH-certified end-of-service-life indicator (ESLI) to shown when breakthrough occurs.

WAC 296-62-07540 (Cont.)

(B) Unless the canister contains a NIOSH-certified ESLI to show when breakthrough occurs, replace canisters used in atmospheres up to 7.5 ppm (10 x PEL) every four hours and industrial-sized canisters used in atmospheres up to 75 ppm (100 x PEL) every two hours, or at the end of the workshift, whichever occurs first.

(c) Respirator selection.

(i) The employer must select appropriate respirators from Table 1 of this section.

TABLE 1
MINIMUM REQUIREMENTS FOR
RESPIRATORY PROTECTION AGAINST FORMALDEHYDE

Condition of use of formaldehyde concentration (ppm)	Minimum respirator required[1]
Up to 7.5 ppm (10 x PEL)	Full facepiece with cartridges or canisters specifically approved for protection against formaldehyde[2].
Up to 75 ppm (100 x PEL)	Full-face mask with chin style or chest or back mounted type industrial size canister specifically approved for protection against formaldehyde. Type C supplied-air respirator pressure demand or continuous flow type, with full facepiece, hood, or helmet.
Above 75 ppm or unknown (emergencies) (100 x PEL)	Self-contained breathing apparatus (SCBA) with positive-pressure full facepiece. Combination supplied-air, full facepiece positive-pressure respirator with auxiliary self-contained air supply.
Fire fighting	SCBA with positive-pressure in full facepiece.
Escape	SCBA in demand or pressure demand mode. Full-face mask with chin style or front or back mounted type industrial size canister specifically approved for protection against formaldehyde.

[1]Respirators specified for use at higher concentrations may be used at lower concentrations.

[2] A half-mask respirator with cartridges specifically approved for protection against formaldehyde can be substituted for the full facepiece respirator providing that effective gas-proof goggles are provided and used in combination with the half-mask respirator.

(ii) The employer must provide a powered air-purifying respirator adequate to protect against formaldehyde exposure to any employee who has difficulty using a negative-pressure respirator.

(8) **Protective equipment and clothing.** Employers shall comply with the provisions of WAC 296-800-160. When protective equipment or clothing is provided under these provisions, the employer shall provide these protective devices at no cost to the employee and assure that the employee wears them.

(a) Selection. The employer shall select protective clothing and equipment based upon the form of formaldehyde to be encountered, the conditions of use, and the hazard to be prevented.

WAC 296-62-07540 (Cont.)

(i) All contact of the eyes and skin with liquids containing one percent or more formaldehyde shall be prevented by the use of chemical protective clothing made of material impervious to formaldehyde and the use of other personal protective equipment, such as goggles and face shields, as appropriate to the operation.

(ii) Contact with irritating or sensitizing materials shall be prevented to the extent necessary to eliminate the hazard.

(iii) Where a face shield is worn, chemical safety goggles are also required if there is a danger of formaldehyde reaching the area of the eye.

(iv) Full body protection shall be worn for entry into areas where concentrations exceed 100 ppm and for emergency reentry into areas of unknown concentration.

(b) Maintenance of protective equipment and clothing.

(i) The employer shall assure that protective equipment and clothing that has become contaminated with formaldehyde is cleaned or laundered before its reuse.

(ii) When ventilating formaldehyde-contaminated clothing and equipment, the employer shall establish a storage area so that employee exposure is minimized. Containers for contaminated clothing and equipment and storage areas shall have labels and signs containing the following information:

DANGER
FORMALDEHYDE-CONTAMINATED (CLOTHING) EQUIPMENT
AVOID INHALATION AND SKIN CONTACT

(iii) The employer shall assure that only persons trained to recognize the hazards of formaldehyde remove the contaminated material from the storage area for purposes of cleaning, laundering, or disposal.

(iv) The employer shall assure that no employee takes home equipment or clothing that is contaminated with formaldehyde.

(v) The employer shall repair or replace all required protective clothing and equipment for each affected employee as necessary to assure its effectiveness.

(vi) The employer shall inform any person who launders, cleans, or repairs such clothing or equipment of formaldehyde's potentially harmful effects and of procedures to safely handle the clothing and equipment.

(9) **Hygiene protection.**

(a) The employer shall provide change rooms, as described in WAC 296-24-120 for employees who are required to change from work clothing into protective clothing to prevent skin contact with formaldehyde.

(b) If employees' skin may become splashed with solutions containing one percent or greater formaldehyde, for example because of equipment failure or improper work practices, the employer shall provide conveniently located quick drench showers and assure that affected employees use these facilities immediately.

WAC 296-62-07540 (Cont.)

(c) If there is any possibility that an employee's eyes may be splashed with solutions containing 0.1 percent or greater formaldehyde, the employer shall provide acceptable eyewash facilities within the immediate work area for emergency use.

(10) **Housekeeping.** For operations involving formaldehyde liquids or gas, the employer shall conduct a program to detect leaks and spills, including regular visual inspections.

(a) Preventative maintenance of equipment, including surveys for leaks, shall be undertaken at regular intervals.

(b) In work areas where spillage may occur, the employer shall make provisions to contain the spill, to decontaminate the work area, and to dispose of the waste.

(c) The employer shall assure that all leaks are repaired and spills are cleaned promptly by employees wearing suitable protective equipment and trained in proper methods for cleanup and decontamination.

(d) Formaldehyde-contaminated waste and debris resulting from leaks or spills shall be placed for disposal in sealed containers bearing a label warning of formaldehyde's presence and of the hazards associated with formaldehyde.

(11) **Emergencies.** For each workplace where there is the possibility of an emergency involving formaldehyde, the employer shall assure appropriate procedures are adopted to minimize injury and loss of life. Appropriate procedures shall be implemented in the event of an emergency.

(12) **Medical surveillance.**

(a) Employees covered.

(i) The employer shall institute medical surveillance programs for all employees exposed to formaldehyde at concentrations at or exceeding the action level or exceeding the STEL.

(ii) The employer shall make medical surveillance available for employees who develop signs and symptoms of overexposure to formaldehyde and for all employees exposed to formaldehyde in emergencies. When determining whether an employee may be experiencing signs and symptoms of possible overexposure to formaldehyde, the employer may rely on the evidence that signs and symptoms associated with formaldehyde exposure will occur only in exceptional circumstances when airborne exposure is less than 0.1 ppm and when formaldehyde is present in materials in concentrations less than 0.1 percent.

(b) Examination by a physician. All medical procedures, including administration of medical disease questionnaires, shall be performed by or under the supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(c) Medical disease questionnaire. The employer shall make the following medical surveillance available to employees prior to assignment to a job where formaldehyde exposure is at or above the action level or above the STEL and annually thereafter. The employer shall also make the following medical surveillance available promptly upon determining that an employee is experiencing signs and symptoms indicative of possible overexposure to formaldehyde.

WAC 296-62-07540 (Cont.)

(i) Administration of a medical disease questionnaire, such as in Appendix D, which is designed to elicit information on work history, smoking history, any evidence of eye, nose, or throat irritation; chronic airway problems or hyperreactive airway disease; allergic skin conditions or dermatitis; and upper or lower respiratory problems.

(ii) A determination by the physician, based on evaluation of the medical disease questionnaire, of whether a medical examination is necessary for employees not required to wear respirators to reduce exposure to formaldehyde.

(d) Medical examinations. Medical examinations shall be given to any employee who the physician feels, based on information in the medical disease questionnaire, may be at increased risk from exposure to formaldehyde and at the time of initial assignment and at least annually thereafter to all employees required to wear a respirator to reduce exposure to formaldehyde. The medical examination shall include:

(i) A physical examination with emphasis on evidence of irritation or sensitization of the skin and respiratory system, shortness of breath, or irritation of the eyes.

(ii) Laboratory examinations for respirator wearers consisting of baseline and annual pulmonary function tests. As a minimum, these tests shall consist of forced vital capacity (FVC), forced expiratory volume in one second (FEV1), and forced expiratory flow (FEF).

(iii) Any other test which the examining physician deems necessary to complete the written opinion.

(iv) Counseling of employees having medical conditions that would be directly or indirectly aggravated by exposure to formaldehyde on the increased risk of impairment of their health.

(e) Examinations for employees exposed in an emergency. The employer shall make medical examinations available as soon as possible to all employees who have been exposed to formaldehyde in an emergency.

(i) The examination shall include a medical and work history with emphasis on any evidence of upper or lower respiratory problems, allergic conditions, skin reaction or hypersensitivity, and any evidence of eye, nose, or throat irritation.

(ii) Other examinations shall consist of those elements considered appropriate by the examining physician.

(f) Information provided to the physician. The employer shall provide the following information to the examining physician:

(i) A copy of this standard and Appendices A, C, D, and E;

(ii) A description of the affected employee's job duties as they relate to the employee's exposure to formaldehyde;

(iii) The representative exposure level for the employee's job assignment;

(iv) Information concerning any personal protective equipment and respiratory protection used or to be used by the employee; and

WAC 296-62-07540 (Cont.)

(v) Information from previous medical examinations of the affected employee within the control of the employer.

(vi) In the event of a nonroutine examination because of an emergency, the employer shall provide to the physician as soon as possible: A description of how the emergency occurred and the exposure the victim may have received.

(g) Physician's written opinion.

(i) For each examination required under this standard, the employer shall obtain a written opinion from the examining physician. This written opinion shall contain the results of the medical examination except that it shall not reveal specific findings or diagnoses unrelated to occupational exposure to formaldehyde. The written opinion shall include:

(A) The physician's opinion as to whether the employee has any medical condition that would place the employee at an increased risk of material impairment of health from exposure to formaldehyde;

(B) Any recommended limitations on the employee's exposure or changes in the use of personal protective equipment, including respirators;

(C) A statement that the employee has been informed by the physician of any medical conditions which would be aggravated by exposure to formaldehyde, whether these conditions may have resulted from past formaldehyde exposure or from exposure in an emergency, and whether there is a need for further examination or treatment.

(ii) The employer shall provide for retention of the results of the medical examination and tests conducted by the physician.

(iii) The employer shall provide a copy of the physician's written opinion to the affected employee within fifteen days of its receipt.

(h) Medical removal.

(i) The provisions of this subdivision apply when an employee reports significant irritation of the mucosa of the eyes or of the upper airways, respiratory sensitization, dermal irritation, or dermal sensitization attributed to workplace formaldehyde exposure. Medical removal provisions do not apply in case of dermal irritation or dermal sensitization when the product suspected of causing the dermal condition contains less than 0.05% formaldehyde.

(ii) An employee's report of signs or symptoms of possible overexposure to formaldehyde shall be evaluated by a physician selected by the employer pursuant to (c) of this subsection. If the physician determines that a medical examination is not necessary under (c)(ii) of this subsection, there shall be a two-week evaluation and remediation period to permit the employer to ascertain whether the signs or symptoms subside untreated or with the use of creams, gloves, first aid treatment, or personal protective equipment. Industrial hygiene measures that limit the employee's exposure to formaldehyde may also be implemented during this period. The employee shall be referred immediately to a physician prior to expiration of the two-week period if the signs or symptoms worsen. Earnings, seniority, and benefits may not be altered during the two-week period by virtue of the report.

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(iii) If the signs or symptoms have not subsided or been remedied by the end of the two-week period, or earlier if signs or symptoms warrant, the employee shall be examined by a physician selected by the employer. The physician shall presume, absent contrary evidence, that observed dermal irritation or dermal sensitization are not attributable to formaldehyde when products to which the affected employee is exposed contain less than 0.1% formaldehyde.

(iv) Medical examinations shall be conducted in compliance with the requirements of (e)(i) and (ii) of this subsection. Additional guidelines for conducting medical exams are contained in WAC 296-62-07546, Appendix C.

(v) If the physician finds that significant irritation of the mucosa of the eyes or the upper airways, respiratory sensitization, dermal irritation, or dermal sensitization result from workplace formaldehyde exposure and recommends restrictions or removal. The employer shall promptly comply with the restrictions or recommendations of removal. In the event of a recommendation of removal, the employer shall remove the affected employee from the current formaldehyde exposure and if possible, transfer the employee to work having no or significantly less exposure to formaldehyde.

(vi) When an employee is removed pursuant to item (v) of this subdivision, the employer shall transfer the employee to comparable work for which the employee is qualified or can be trained in a short period (up to six months), where the formaldehyde exposures are as low as possible, but not higher than the action level. The employer shall maintain the employee's current earnings, seniority, and other benefits. If there is no such work available, the employer shall maintain the employee's current earnings, seniority, and other benefits until such work becomes available, until the employee is determined to be unable to return to workplace formaldehyde exposure, until the employee is determined to be able to return to the original job status, or for six months, whichever comes first.

(vii) The employer shall arrange for a follow-up medical examination to take place within six months after the employee is removed pursuant to this subsection. This examination shall determine if the employee can return to the original job status, or if the removal is to be permanent. The physician shall make a decision within six months of the date the employee was removed as to whether the employee can be returned to the original job status, or if the removal is to be permanent.

(viii) An employer's obligation to provide earnings, seniority, and other benefits to a removed employee may be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program or from employment with another employer made possible by virtue of the employee's removal.

(ix) In making determinations of the formaldehyde content of materials under this subsection the employer may rely on objective data.

(i) Multiple physician review.

(i) After the employer selects the initial physician who conducts any medical examination or consultation to determine whether medical removal or restriction is appropriate, the employee may designate a second physician to review any findings, determinations, or recommendations of the initial physician and to conduct such examinations, consultations, and laboratory tests as the second physician deems necessary and appropriate to evaluate the effects of formaldehyde exposure and to facilitate this review.

WAC 296-62-07540 (Cont.)

(ii) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation for the purpose of medical removal or restriction.

(iii) The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen days after receipt of the notification of the right to seek a second medical opinion, or receipt of the initial physician's written opinion, whichever is later:

(A) The employee informs the employer of the intention to seek a second medical opinion; and

(B) The employee initiates steps to make an appointment with a second physician.

(iv) If the findings, determinations, or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve the disagreement. If the two physicians are unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician who shall be a specialist in the field at issue:

(A) To review the findings, determinations, or recommendations of the prior physicians; and

(B) To conduct such examinations, consultations, laboratory tests, and discussions with prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(v) In the alternative, the employer and the employee or authorized employee representative may jointly designate such third physician.

(vi) The employer shall act consistent with the findings, determinations, and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(13) **Hazard communication.**

(a) General. Notwithstanding any exemption granted in WAC 296-800-170 for wood products, each employer who has a workplace covered by this standard shall comply with the requirements of WAC 296-800-170. The definitions of the chemical hazard communication standard shall apply under this standard.

(i) The following shall be subject to the hazard communication requirements of this section: Formaldehyde gas, all mixtures or solutions composed of greater than 0.1 percent formaldehyde, and materials capable of releasing formaldehyde into the air under reasonably foreseeable concentrations reaching or exceeding 0.1 ppm.

(ii) As a minimum, specific health hazards that the employer shall address are: Cancer, irritation and sensitization of the skin and respiratory system, eye and throat irritation, and acute toxicity.

WAC 296-62-07540 (Cont.)

(b) Manufacturers and importers who produce or import formaldehyde or formaldehyde-containing products shall provide downstream employers using or handling these products with an objective determination through the required labels and MSDSs if these items may constitute a health hazard within the meaning of WAC 296-62-05407 under normal conditions of use.

(c) Labels.

(i) The employer shall assure that hazard warning labels complying with the requirements of WAC 296-800-170 are affixed to all containers of materials listed in (a)(i) of this subsection, except to the extent that (a)(i) of this subsection is inconsistent with this item.

(ii) Information on labels. As a minimum, for all materials listed in (a)(i) of this subsection, capable of releasing formaldehyde at levels of 0.1 ppm to 0.5 ppm, labels shall identify that the product contains formaldehyde: List the name and address of the responsible party; and state that physical and health hazard information is readily available from the employer and from material safety data sheets.

(iii) For materials listed in (a)(i) of this subsection, capable of releasing formaldehyde at levels above 0.5 ppm, labels shall appropriately address all the hazards as defined in WAC 296-800-170, and Appendices A and B, including respiratory sensitization, and shall contain the words “Potential Cancer Hazard.”

(iv) In making the determinations of anticipated levels of formaldehyde release, the employer may rely on objective data indicating the extent of potential formaldehyde release under reasonably foreseeable conditions of use.

(v) Substitute warning labels. The employer may use warning labels required by other statutes, regulations, or ordinances which impart the same information as the warning statements required by this subitem.

(d) Material safety data sheets.

(i) Any employer who uses formaldehyde-containing materials listed in (a)(i) of this subsection shall comply with the requirements of WAC 296-800-170 with regard to the development and updating of material safety data sheets.

(ii) Manufacturers, importers, and distributors of formaldehyde containing materials listed in (a)(i) of this subsection shall assure that material safety data sheets and updated information are provided to all employers purchasing such materials at the time of the initial shipment and at the time of the first shipment after a material safety data sheet is updated.

(e) Written hazard communication program. The employer shall develop, implement, and maintain at the workplace, a written chemical hazard communication program for formaldehyde exposures in the workplace, which at a minimum describes how the requirements specified in this section for labels and other forms of warning and material safety data sheets, and subsection (14) of this section for employee information and training, will be met. Employees in multi-employer workplaces shall comply with the requirements of WAC 296-800-170.

(14) **Employee information and training.**

(a) Participation. The employer shall assure that all employees who are assigned to workplaces where there is a health hazard from formaldehyde participate in a training program, except that where the

WAC 296-62-07540 (Cont.)

employer can show, using objective data, that employees are not exposed to formaldehyde at or above 0.1 ppm, the employer is not required to provide training.

(b) Frequency. Employers shall provide such information and training to employees at the time of their initial assignment and whenever a new exposure to formaldehyde is introduced into their work area. The training shall be repeated at least annually.

(c) Training program. The training program shall be conducted in a manner which the employee is able to understand and shall include:

(i) A discussion of the contents of this regulation and the contents of the material safety data sheet;

(ii) The purpose for and a description of the medical surveillance program required by this standard, including:

(A) A description of the potential health hazards associated with exposure to formaldehyde and a description of the signs and symptoms of exposure to formaldehyde.

(B) Instructions to immediately report to the employer the development of any adverse signs or symptoms that the employee suspects is attributable to formaldehyde exposure.

(iii) Description of operations in the work area where formaldehyde is present and an explanation of the safe work practices appropriate for limiting exposure to formaldehyde in each job;

(iv) The purpose for, proper use of, and limitations of personal protective clothing;

(v) Instructions for the handling of spills, emergencies, and clean-up procedures;

(vi) An explanation of the importance of engineering and work practice controls for employee protection and any necessary instruction in the use of these controls;

(vii) A review of emergency procedures including the specific duties or assignments of each employee in the event of an emergency; and

(viii) The purpose, proper use, limitations, and other training requirements for respiratory protection as required by chapter 296-62 WAC, Part E.

(d) Access to training materials.

(i) The employer shall inform all affected employees of the location of written training materials and shall make these materials readily available, without cost, to the affected employees.

(ii) The employer shall provide, upon request, all training materials relating to the employee training program to the director of labor and industries, or his/her designated representative.

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(15) **Recordkeeping.**

(a) Exposure measurements. The employer shall establish and maintain an accurate record of all measurements taken to monitor employee exposure to formaldehyde. This record shall include:

(i) The date of measurement;

(ii) The operation being monitored;

(iii) The methods of sampling and analysis and evidence of their accuracy and precision;

(iv) The number, durations, time, and results of samples taken;

(v) The types of protective devices worn; and

(vi) The names, job classifications, Social Security numbers, and exposure estimates of the employees whose exposures are represented by the actual monitoring results.

(b) Exposure determinations. Where the employer has determined that no monitoring is required under this standard, the employer shall maintain a record of the objective data relied upon to support the determination that no employee is exposed to formaldehyde at or above the action level.

(c) Medical surveillance. The employer shall establish and maintain an accurate record for each employee subject to medical surveillance under this standard. This record shall include:

(i) The name and Social Security number of the employee;

(ii) The physician's written opinion;

(iii) A list of any employee health complaints that may be related to exposure to formaldehyde; and

(iv) A copy of the medical examination results, including medical disease questionnaires and results of any medical tests required by the standard or mandated by the examining physician.

(d) Records retention. The employer shall retain records required by this standard for at least the following periods:

(i) Exposure records and determinations shall be kept for at least thirty years; and

(ii) Medical records shall be kept for the duration of employment plus thirty years;

(e) Availability of records.

(i) Upon request, the employer shall make all records maintained as a requirement of this standard available for examination and copying to the director of labor and industries, or his/her designated representative.

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(ii) The employer shall make employee exposure records, including estimates made from representative monitoring and available upon request for examination and copying, to the subject employee, or former employee, and employee representatives in accordance with WAC 296-62-052 through 296-62-05209 and 296-62-05213 through 296-62-05217 and WAC 296-800-180.

(iii) Employee medical records required by this standard shall be provided upon request for examination and copying, to the subject employee, or former employee, or to anyone having the specific written consent of the subject employee or former employee in accordance with WAC 296-62-05201 through 296-62-05209, and 296-62-05213 through 296-62-05217.

[Statutory Authority: RCW 49.17.010, .040, .050. 02-12-098 (Order 00-20), § 296-62-07540, filed 06/05/02, effective 08/01/02. Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07540, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07540, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-07540, filed 7/20/94, effective 9/20/94; 92-23-017 (Order 92-13), 296-62-07540, filed 11/10/92, effective 12/18/92; 91-11-070 (Order 91-01), 296-62-07540, filed 5/20/91, effective 6/20/91; 90-03-029 (Order 89-20), 296-62-07540, filed 1/11/90, effective 2/26/90; 88-21-002 (Order 88-23), 296-62-07540, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07542 Appendix A--Substance technical guideline for formalin.

(1) The following substance technical guideline for formalin provides information on uninhibited formalin solution (thirty-seven percent formaldehyde, no methanol stabilizer). It is designed to inform employees at the production level of their rights and duties under the formaldehyde standard whether their job title defines them as workers or supervisors. Much of the information provided is general; however, some information is specific for formalin. When employee exposure to formaldehyde is from resins capable of releasing formaldehyde, the resin itself and other impurities or decomposition products may also be toxic, and employers should include this information as well when informing employees of the hazards associated with the materials they handle. The precise hazards associated with exposure to formaldehyde depend both on the form (solid, liquid, or gas) of the material and the concentration of formaldehyde present. For example, thirty-seven to fifty percent solutions of formaldehyde present a much greater hazard to the skin and eyes from spills or splashes than solutions containing less than one percent formaldehyde. Individual substance technical guidelines used by the employer for training employees should be modified to properly give information on the material actually being used.

(a) Substance identification.

(i) Chemical name: Formaldehyde.

(ii) Chemical family: Aldehyde.

(iii) Chemical formula: HCHO.

(iv) Molecular weight: 30.03.

(v) Chemical abstracts service number (CAS number): 50-00-0.

Synonyms: Formalin; Formic Aldehyde; Paraform; Formol; Formalin (Methanol-free); Fyde; Formalith; Methanal; Methyl Aldehyde; Methylene Glycol; Methylene Oxide; Tetraoxymethalene; Oxomethane; Oxymethylene.

(b) Components and contaminants.

(i) Percent: 37.0 Formaldehyde.

(ii) Percent: 63.0 water.

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Note: Inhibited solutions contain methanol.

(iii) Other contaminants: Formic acid (alcohol free).

Exposure limits:

(A) WISHA TWA-0.75 ppm.

(B) WISHA STEL-2 ppm.

(c) Physical data.

(i) Description: Colorless liquid, pungent odor.

(ii) Boiling point: 214°F (101°C).

(iii) Specific gravity: 1.08 (H_2O = 1 @ 20 C).

(iv) pH: 2.8-4.0.

(v) Solubility in water: Miscible.

(vi) Solvent solubility: Soluble in alcohol and acetone.

(vii) Vapor density: 1.04 (Air = 1 @ 20 C).

(viii) Odor threshold: 0.8-1 ppm.

(d) Fire and explosion hazard.

(i) Moderate fire and explosion hazard when exposed to heat or flame.

(ii) The flash point of thirty-seven percent formaldehyde solutions is above normal room temperature, but the explosion range is very wide, from seven to seventy-three percent by volume in air.

(iii) Reaction of formaldehyde with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid yields explosive compounds.

(iv) Flash point: 185°F (85°C) closed cup.

(v) Lower explosion limit: Seven percent.

(vi) Upper explosion limit: Seventy-three percent.

(vii) Autoignition temperature: 806°F (430°C).

(viii) Flammable class (WISHA): III A.

Extinguishing media:

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(I) Use dry chemical, "alcohol foam," carbon dioxide, or water in flooding amounts as fog. Solid streams may not be effective. Cool fire-exposed containers with water from side until well after fire is out.

(II) Use of water spray to flush spills can also dilute the spill to produce nonflammable mixtures. Water runoff, however, should be contained for treatment.

(ix) National Fire Protection Association Section 325M Designation:

(A) Health: 2-Materials hazardous to health, but areas may be entered with full-faced mask self-contained breathing apparatus which provides eye protection.

(B) Flammability: 2-Materials which must be moderately heated before ignition will occur. Water spray may be used to extinguish the fire because the material can be cooled below its flash point.

(C) Reactivity: D-Materials which (in themselves) are normally stable even under fire exposure conditions and which are not reactive with water. Normal fire fighting procedures may be used.

(e) Reactivity.

(i) Stability: Formaldehyde solutions may self-polymerize to form paraformaldehyde which precipitates.

(ii) Incompatibility (materials to avoid):

(A) Strong oxidizing agents, caustics, strong alkalies, isocyanates, anhydrides, oxides, and inorganic acids.

(B) Formaldehyde reacts with hydrochloric acid to form the potent carcinogen, bis-chloromethyl ether. Formaldehyde reacts with nitrogen dioxide, nitromethane, perchloric acid and aniline, or peroxyformic acid to yield explosive compounds. A violent reaction occurs when formaldehyde is mixed with strong oxidizers.

(C) Hazardous combustion or decomposition products: Oxygen from the air can oxidize formaldehyde to formic acid, especially when heated. Formic acid is corrosive.

(f) Health hazard data.

(i) Acute effects of exposure.

(A) Ingestion (swallowing): Liquids containing ten to forty percent formaldehyde cause severe irritation and inflammation of the mouth, throat, and stomach. Severe stomach pains will follow ingestion with possible loss of consciousness and death. Ingestion of dilute formaldehyde solutions (0.03-0.04%) may cause discomfort in the stomach and pharynx.

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(B) Inhalation (breathing):

(I) Formaldehyde is highly irritating to the upper respiratory tract and eyes. Concentrations of 0.5 to 2.0 ppm may irritate the eyes, nose, and throat of some individuals.

(II) Concentrations of 3 to 5 ppm also cause tearing of the eyes and are intolerable to some persons.

(III) Concentrations of 10 to 20 ppm cause difficulty in breathing, burning of the nose and throat, coughing, and heavy tearing of the eyes, and 25 to 30 ppm causes severe respiratory tract injury leading to pulmonary edema and pneumonitis. A concentration of 100 ppm is immediately dangerous to life and health. Deaths from accidental exposure to high concentrations of formaldehyde have been reported.

(C) Skin (dermal): Formalin is a severe skin irritant and a sensitizer. Contact with formalin causes white discoloration, smarting, drying, cracking, and scaling. Prolonged and repeated contact can cause numbness and a hardening or tanning of the skin. Previously exposed persons may react to future exposure with an allergic eczematous dermatitis or hives.

(D) Eye contact: Formaldehyde solutions splashed in the eye can cause injuries ranging from transient discomfort to severe, permanent corneal clouding and loss of vision. The severity of the effect depends on the concentration of formaldehyde in the solution and whether or not the eyes are flushed with water immediately after the accident.

Note: The perception of formaldehyde by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This can lead to overexposure if a worker is relying on formaldehyde's warning properties to alert him or her to the potential for exposure.

(E) Acute animal toxicity:

(I) Oral, rats: LD50 = 800 mg/kg.

(II) Oral, mouse: LD50 = 42 mg/kg.

(III) Inhalation, rats: LC50 = 250 mg/kg.

(IV) Inhalation, mouse: LC50 = 900 mg/kg.

(V) Inhalation, rats: LC50 = 590 mg/kg.

(g) Chronic effects of exposure.

(i) Carcinogenicity: Formaldehyde has the potential to cause cancer in humans. Repeated and prolonged exposure increases the risk. Various animal experiments have conclusively shown formaldehyde to be a carcinogen in rats. In humans, formaldehyde exposure has been associated with cancers of the lung, nasopharynx and oropharynx, and nasal passages.

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(ii) Mutagenicity: Formaldehyde is genotoxic in several in vitro test systems showing properties of both an initiator and a promoter.

(iii) Toxicity: Prolonged or repeated exposure to formaldehyde may result in respiratory impairment. Rats exposed to formaldehyde at 2 ppm developed benign nasal tumors and changes of the cell structure in the nose as well as inflamed mucous membranes of the nose. Structural changes in the epithelial cells in the human nose have also been observed. Some persons have developed asthma or bronchitis following exposure to formaldehyde, most often as the result of an accidental spill involving a single exposure to a high concentration of formaldehyde.

(h) Emergency and first-aid procedures.

(i) Ingestion (swallowing): If the victim is conscious, dilute, inactivate, or absorb the ingested formaldehyde by giving milk, activated charcoal, or water. Any organic material will inactivate formaldehyde. Keep affected person warm and at rest. Get medical attention immediately. If vomiting occurs, keep head lower than hips.

(ii) Inhalation (breathing): Remove the victim from the exposure area to fresh air immediately. Where the formaldehyde concentration may be very high, each rescuer must put on a self-contained breathing apparatus before attempting to remove the victim, and medical personnel should be informed of the formaldehyde exposure immediately. If breathing has stopped, give artificial respiration. Keep the affected person warm and at rest. Qualified first-aid or medical personnel should administer oxygen, if available, and maintain the patient's airways and blood pressure until the victim can be transported to a medical facility. If exposure results in a highly irritated upper respiratory tract and coughing continues for more than ten minutes, the worker should be hospitalized for observation and treatment.

(iii) Skin contact: Remove contaminated clothing (including shoes) immediately. Wash the affected area of your body with soap or mild detergent and large amounts of water until no evidence of the chemical remains (at least fifteen to twenty minutes). If there are chemical burns, get first aid to cover the area with sterile, dry dressing, and bandages. Get medical attention if you experience appreciable eye or respiratory irritation.

(iv) Eye contact: Wash the eyes immediately with large amounts of water occasionally lifting lower and upper lids, until no evidence of chemical remains (at least fifteen to twenty minutes). In case of burns, apply sterile bandages loosely without medication. Get medical attention immediately. If you have experienced appreciable eye irritation from a splash or excessive exposure, you should be referred promptly to an ophthalmologist for evaluation.

(i) Emergency procedures.

(i) Emergencies:

(A) If you work in an area where a large amount of formaldehyde could be released in an accident or from equipment failure, your employer must develop procedures to be followed in event of an emergency. You should be trained in your specific duties in the event of an emergency, and it is important that you clearly understand these duties. Emergency equipment must be accessible and you should be trained to use any equipment that you might need. Formaldehyde contaminated equipment must be cleaned before reuse.

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(B) If a spill of appreciable quantity occurs, leave the area quickly unless you have specific emergency duties. Do not touch spilled material. Designated persons may stop the leak and shut off ignition sources if these procedures can be done without risk. Designated persons should isolate the hazard area and deny entry except for necessary people protected by suitable protective clothing and respirators adequate for the exposure. Use water spray to reduce vapors. Do not smoke, and prohibit all flames or flares in the hazard area.

(ii) Special fire fighting procedures:

(A) Learn procedures and responsibilities in the event of a fire in your workplace.

(B) Become familiar with the appropriate equipment and supplies and their location.

(C) In fire fighting, withdraw immediately in case of rising sound from venting safety device or any discoloration of storage tank due to fire.

(j) Spill, leak, and disposal procedures.

(i) Occupational spill: For small containers, place the leaking container in a well ventilated area. Take up small spills with absorbent material and place the waste into properly labeled containers for later disposal. For larger spills, dike the spill to minimize contamination and facilitate salvage or disposal. You may be able to neutralize the spill with sodium hydroxide or sodium sulfite. Your employer must comply with EPA rules regarding the clean-up of toxic waste and notify state and local authorities, if required. If the spill is greater than 1,000 lb/day, it is reportable under EPA's superfund legislation.

(ii) Waste disposal: Your employer must dispose of waste containing formaldehyde in accordance with applicable local, state, and federal law and in a manner that minimizes exposure of employees at the site and of the clean-up crew.

(k) Monitoring and measurement procedures.

(i) Monitoring requirements: If your exposure to formaldehyde exceeds the 0.5 ppm action level or the 2 ppm STEL, your employer must monitor your exposure. Your employer need not measure every exposure if a “high exposure” employee can be identified. This person usually spends the greatest amount of time nearest the process equipment. If you are a “representative employee,” you will be asked to wear a sampling device to collect formaldehyde. This device may be a passive badge, a sorbent tube attached to a pump, or an impinger containing liquid. You should perform your work as usual, but inform the person who is conducting the monitoring of any difficulties you are having wearing the device.

(ii) Evaluation of 8-hour exposure: Measurements taken for the purpose of determining time-weighted average (TWA) exposures are best taken with samples covering the full shift. Samples collected must be taken from the employee's breathing zone air.

(iii) Short-term exposure evaluation: If there are tasks that involve brief but intense exposure to formaldehyde, employee exposure must be measured to assure compliance with the STEL. Sample collections are for brief periods, only fifteen minutes, but several samples may be needed to identify the peak exposure.

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(iv) Monitoring techniques: WISHA's only requirement for selecting a method for sampling and analysis is that the methods used accurately evaluate the concentration of formaldehyde in employees' breathing zones. Sampling and analysis may be performed by collection of formaldehyde on liquid or solid sorbents with subsequent chemical analysis. Sampling and analysis may also be performed by passive diffusion monitors and short-term exposure may be measured by instruments such as real-time continuous monitoring systems and portable direct reading instruments.

(v) Notification of results: Your employer must inform you of the results of exposure monitoring representative of your job. You may be informed in writing, but posting the results where you have ready access to them constitutes compliance with the standard.

(l) Protective equipment and clothing.

(Material impervious to formaldehyde is needed if the employee handles formaldehyde solutions of one percent or more. Other employees may also require protective clothing or equipment to prevent dermatitis.)

(i) Respiratory protection. Use NIOSH-approved full facepiece negative pressure respirators equipped with approved cartridges or canisters within the use limitations of these devices. (Present restrictions on cartridges and canisters do not permit them to be used for a full workshift.) In all other situations, use positive pressure respirators such as the positive-pressure air purifying respirator or the self-contained breathing apparatus (SCBA).

(ii) Protective gloves:

(A) Wear protective (impervious) gloves provided by your employer, at no cost, to prevent contact with formalin.

(B) Your employer should select these gloves based on the results of permeation testing and in accordance with the ACGIH guidelines for selection of chemical protective clothing.

(iii) Eye protection:

(A) If you might be splashed in the eyes with formalin, it is essential that you wear goggles or some other type of complete protection for the eye.

(B) You may also need a face shield if your face is likely to be splashed with formalin, but you must not substitute face shields for eye protection. (This section pertains to formaldehyde solutions of one percent or more.)

(iv) Other protective equipment:

(A) You must wear protective (impervious) clothing and equipment provided by your employer at no cost to prevent repeated or prolonged contact with formaldehyde liquids.

(B) If you are required to change into whole-body chemical protective clothing, your employer must provide a change room for your privacy and for storage of your normal clothing.

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(C) If you are splashed with formaldehyde, use the emergency showers and eyewash fountains provided by your employer immediately to prevent serious injury. Report the incident to your supervisor and obtain necessary medical support.

(2) **Entry into an IDLH atmosphere.** Enter areas where the formaldehyde concentration might be 100 ppm or more only with complete body protection including a self-contained breathing apparatus with a full facepiece operated in a positive pressure mode or a supplied-air respirator with full facepiece and operated in a positive pressure mode. This equipment is essential to protect your life and health under such extreme conditions.

(a) Engineering controls.

(i) Ventilation is the most widely applied engineering control method for reducing the concentration of airborne substances in the breathing zones of workers. There are two distinct types of ventilation.

(ii) Local exhaust: Local exhaust ventilation is designed to capture airborne contaminants as near to the point of generation as possible. To protect you, the direction of contaminant flow must always be toward the local exhaust system inlet and away from you.

(iii) General (mechanical):

(A) General dilution ventilation involves continuous introduction of fresh air into the workroom to mix with the contaminated air and lower your breathing zone concentration of formaldehyde. Effectiveness depends on the number of air changes per hour.

(B) Where devices emitting formaldehyde are spread out over a large area, general dilution ventilation may be the only practical method of control.

(iv) Work practices: Work practices and administrative procedures are an important part of a control system. If you are asked to perform a task in a certain manner to limit your exposure to formaldehyde, it is extremely important that you follow these procedures.

(b) Medical surveillance.

(i) Medical surveillance helps to protect employees' health. You are encouraged strongly to participate in the medical surveillance program.

(ii) Your employer must make a medical surveillance program available at no expense to you and at a reasonable time and place if you are exposed to formaldehyde at concentrations above 0.5 ppm as an 8-hour average or 2 ppm over any fifteen-minute period.

(A) You will be offered medical surveillance at the time of your initial assignment and once a year afterward as long as your exposure is at least 0.5 ppm (action level) or 2 ppm (STEL).

(B) Even if your exposure is below these levels, you should inform your employer if you have signs and symptoms that you suspect, through your training, are related to your formaldehyde exposure because you may need medical surveillance to determine if your health is being impaired by your exposure.

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(iii) The surveillance plan includes:

(A) A medical disease questionnaire.

(B) A physical examination if the physician determines this is necessary.

(iv) If you are required to wear a respirator, your employer must offer you a physical examination and a pulmonary function test every year.

(v) The physician must collect all information needed to determine if you are at increased risk from your exposure to formaldehyde. At the physician's discretion, the medical examination may include other tests, such as a chest x-ray, to make this determination.

(vi) After a medical examination the physician will provide your employer with a written opinion which includes any special protective measures recommended and any restrictions on your exposure. The physician must inform you of any medical conditions you have which would be aggravated by exposure to formaldehyde. All records from your medical examinations, including disease surveys, must be retained at your employer's expense.

(c) Emergencies.

(i) If you are exposed to formaldehyde in an emergency and develop signs or symptoms associated with acute toxicity from formaldehyde exposure, your employer must provide you with a medical examination as soon as possible.

(ii) This medical examination will include all steps necessary to stabilize your health.

(iii) You may be kept in the hospital for observation if your symptoms are severe to ensure that any delayed effects are recognized and treated.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-17-094 (Order 99-01, § 296-62-07542, filed 08/17/99, effective 12/01/99. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-07542, filed 7/20/94, effective 9/20/94; 92-23-017 (Order 92-13), 296-62-07542, filed 11/10/92, effective 12/18/92; 88-21-002 (Order 88-23), 296-62-07542, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07544 Appendix B--Sampling strategy and analytical methods for formaldehyde.

(1) To protect the health of employees, exposure measurements must be unbiased and representative of employee exposure. The proper measurement of employee exposure requires more than a token commitment on the part of the employer. WISHA's mandatory requirements establish a baseline; under the best of circumstances all questions regarding employee exposure will be answered. Many employers, however, will wish to conduct more extensive monitoring before undertaking expensive commitments, such as engineering controls to assure that the modifications are truly necessary. The following sampling strategy, which was developed at NIOSH by Nelson A. Leidel, Kenneth A. Busch, and Jeremiah R. Lynch and described in NIOSH publication No. 77-173 (Occupational Exposure Sampling Strategy Manual) will assist the employer in developing a strategy for determining the exposure of his or her employees.

(2) There is no one correct way to determine employee exposure. Obviously, measuring the exposure of every employee exposed to formaldehyde will provide the most information on any given day. Where few employees are exposed, this may be a practical solution. For most employers, however, use of the following strategy will give just as much information at less cost.

(3) Exposure data collected on a single day will not automatically guarantee the employer that his or her workplace is always in compliance with the formaldehyde standard. This does not imply, however, that it is impossible for an employer to be sure that his or her worksite is in compliance with the standard.

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Indeed, a properly designed sampling strategy showing that all employees are exposed below the PELs, at least with a ninety-five percent certainty, is compelling evidence that the exposure limits are being achieved provided that measurements are conducted using valid sampling strategy and approved analytical methods.

(4) **There are two PELs,** the TWA concentration and the STEL.

(a) Most employers will find that one of these two limits is more critical in the control of their operations, and WISHA expects that the employer will concentrate monitoring efforts on the critical component.

(b) If the more difficult exposure is controlled, this information, along with calculations to support the assumptions, should be adequate to show that the other exposure limit is also being achieved.

(5) **Sampling strategy.**

(a) Determination of the need for exposure measurements.

(b) The employer must determine whether employees may be exposed to concentrations in excess of the action level. This determination becomes the first step in an employee exposure monitoring program that minimizes employer sampling burdens while providing adequate employee protection.

(c) If employees may be exposed above the action level, the employer must measure exposure. Otherwise, an objective determination that employee exposure is low provides adequate evidence that exposure potential has been examined.

(d) The employer should examine all available relevant information, e.g., insurance company and trade association data and information from suppliers or exposure data collected from similar operations.

(e) The employer may also use previously-conducted sampling including area monitoring. The employer must make a determination relevant to each operation although this need not be on a separate piece of paper.

(f) If the employer can demonstrate conclusively that no employee is exposed above the action level or the STEL through the use of objective data, the employer need proceed no further on employee exposure monitoring until such time that conditions have changed and the determination is no longer valid.

(g) If the employer cannot determine that employee exposure is less than the action level and the STEL, employee exposure monitoring will have to be conducted.

(6) **Workplace material survey.**

(a) The primary purpose of a survey of raw material is to determine if formaldehyde is being used in the work environment and if so, the conditions under which formaldehyde is being used.

(b) The first step is to tabulate all situations where formaldehyde is used in a manner such that it may be released into the workplace atmosphere or contaminate the skin. This information should be available through analysis of company records and information on the MSDSs available through provisions of this standard and the hazard communication standard.

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(c) If there is an indication from materials handling records and accompanying MSDSs that formaldehyde is being used in the following types of processes or work operations, there may be a potential for releasing formaldehyde into the workplace atmosphere:

(i) Any operation that involves grinding, sanding, sawing, cutting, crushing, screening, sieving, or any other manipulation of material that generates formaldehyde-bearing dust.

(ii) Any processes where there have been employee complaints or symptoms indicative of exposure to formaldehyde.

(iii) Any liquid or spray process involving formaldehyde.

(iv) Any process that uses formaldehyde in preserved tissue.

(v) Any process that involves the heating of a formaldehyde-bearing resin.

Processes and work operations that use formaldehyde in these manners will probably require further investigation at the worksite to determine the extent of employee monitoring that should be conducted.

(7) **Workplace observations.**

(a) To this point, the only intention has been to provide an indication as to the existence of potentially exposed employees. With this information, a visit to the workplace is needed to observe work operations, to identify potential health hazards, and to determine whether any employees may be exposed to hazardous concentrations of formaldehyde.

(b) In many circumstances, sources of formaldehyde can be identified through the sense of smell. However, this method of detection should be used with caution because of olfactory fatigue.

(c) Employee location in relation to source of formaldehyde is important in determining if an employee may be significantly exposed to formaldehyde. In most instances, the closer a worker is to the source, the higher the probability that a significant exposure will occur.

(d) Other characteristics should be considered. Certain high temperature operations give rise to higher evaporation rates. Locations of open doors and windows provide natural ventilation that tend to dilute formaldehyde emissions. General room ventilation also provides a measure of control.

(8) **Calculation of potential exposure concentrations.**

(a) By knowing the ventilation rate in a workplace and the quantity of formaldehyde generated, the employer may be able to determine by calculation if the PELs might be exceeded.

(b) To account for poor mixing of formaldehyde into the entire room, locations of fans and proximity of employees to the work operation, the employer must include a safety factor.

(c) If an employee is relatively close to a source, particularly if he or she is located downwind, a safety factor of one hundred may be necessary.

(d) For other situations, a factor of ten may be acceptable. If the employer can demonstrate through such calculations that employee exposure does not exceed the action level or the STEL, the employer may use this information as objective data to demonstrate compliance with the standard.

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(9) **Sampling strategy.**

(a) Once the employer determines that there is a possibility of substantial employee exposure to formaldehyde, the employer is obligated to measure employee exposure.

(b) The next step is selection of a maximum risk employee. When there are different processes where employees may be exposed to formaldehyde, a maximum risk employee should be selected for each work operation.

(c) Selection of the maximum risk employee requires professional judgment. The best procedure for selecting the maximum risk employee is to observe employees and select the person closest to the source of formaldehyde. Employee mobility may affect this selection; e.g., if the closest employee is mobile in his tasks, he may not be the maximum risk employee. Air movement patterns and differences in work habits will also affect selection of the maximum risk employee.

(d) When many employees perform essentially the same task, a maximum risk employee cannot be selected. In this circumstance, it is necessary to resort to random sampling of the group of workers. The objective is to select a subgroup of adequate size so that there is a high probability that the random sample will contain at least one worker with high exposure if one exists. The number of persons in the group influences the number that need to be sampled to ensure that at least one individual from the highest ten percent exposure group is contained in the sample. For example, to have ninety percent confidence in the results, if the group size is ten, nine should be sampled; for fifty, only eighteen need to be sampled.

(e) If measurement shows exposure to formaldehyde at or above the action level or the STEL, the employer needs to identify all other employees who may be exposed at or above the action level or STEL and measure or otherwise accurately characterize the exposure of these employees.

(f) Whether representative monitoring or random sampling are conducted, the purpose remains the same to determine if the exposure of any employee is above the action level. If the exposure of the most exposed employee is less than the action level and the STEL, regardless of how the employee is identified, then it is reasonable to assume that measurements of exposure of the other employees in that operation would be below the action level and the STEL.

(10) **Exposure measurements.**

(a) There is no “best” measurement strategy for all situations. Some elements to consider in developing a strategy are:

(i) Availability and cost of sampling equipment;

(ii) Availability and cost of analytic facilities;

(iii) Availability and cost of personnel to take samples;

(iv) Location of employees and work operations;

(v) Intraday and interday variations in the process;

(vi) Precision and accuracy of sampling and analytic methods; and

(vii) Number of samples needed.

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(b) Samples taken for determining compliance with the STEL differ from those that measure the TWA concentration in important ways. STEL samples are best taken in a nonrandom fashion using all available knowledge relating to the area, the individual, and the process to obtain samples during periods of maximum expected concentrations. At least three measurements on a shift are generally needed to spot gross errors or mistakes; however, only the highest value represents the STEL.

(c) If an operation remains constant throughout the workshift, a much greater number of samples would need to be taken over the thirty-two discrete nonoverlapping periods in an 8-hour workshift to verify compliance with a STEL. If employee exposure is truly uniform throughout the workshift, however, an employer in compliance with the 1 ppm TWA would be in compliance with the 2 ppm STEL, and this determination can probably be made using objective data.

(11) **Need to repeat the monitoring strategy.**

(a) Interday and intraday fluctuations in employee exposure are mostly influenced by the physical processes that generate formaldehyde and the work habits of the employee. Hence, in-plant process variations influence the employer's determination of whether or not additional controls need to be imposed. Measurements that employee exposure is low on a day that is not representative of worst conditions may not provide sufficient information to determine whether or not additional engineering controls should be installed to achieve the PELs.

(b) The person responsible for conducting sampling must be aware of systematic changes which will negate the validity of the sampling results. Systematic changes in formaldehyde exposure concentration for an employee can occur due to:

(i) The employee changing patterns of movement in the workplace;

(ii) Closing of plant doors and windows;

(iii) Changes in ventilation from season to season;

(iv) Decreases in ventilation efficiency or abrupt failure of engineering control equipment; and

(v) Changes in the production process or work habits of the employee.

(c) Any of these changes, if they may result in additional exposure that reaches the next level of action (i.e., 0.5 or 1.0 ppm as an 8-hour average or 2 ppm over fifteen minutes) require the employer to perform additional monitoring to reassess employee exposure.

(d) A number of methods are suitable for measuring employee exposure to formaldehyde or for characterizing emissions within the worksite. The preamble to this standard describes some methods that have been widely used or subjected to validation testing. A detailed analytical procedure derived from the WISHA Method A.C.R.O. for acrolein and formaldehyde is presented below for informational purposes.

(e) Inclusion of WISHA's method in this appendix in no way implies that it is the only acceptable way to measure employee exposure to formaldehyde. Other methods that are free from significant interferences and that can determine formaldehyde at the permissible exposure limits within .±25 percent of the “true” value at the ninety-five percent confidence level are also acceptable. Where applicable, the method should also be capable of measuring formaldehyde at the action level to ±35 percent of the “true” value with a ninety-five percent confidence level. WISHA encourages

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employers to choose methods that will be best for their individual needs. The employer must exercise caution, however, in choosing an appropriate method since some techniques suffer from interferences that are likely to be present in workplaces of certain industry sectors where formaldehyde is used.

(12) **WISHA's analytical laboratory method.**

A.C.R.O. (also use methods F.O.R.M. and F.O.R.M. 2 when applicable).

(a) Matrix: Air.

(b) Target concentration: 1 ppm (1.2 mg/m^3).

(c) Procedures: Air samples are collected by drawing known volumes of air through sampling tubes containing XAD-2 adsorbent which have been coated with 2-(hydroxymethyl) piperidine. The samples are desorbed with toluene and then analyzed by gas chromatography using a nitrogen selective detector.

(d) Recommended sampling rate and air volumes: 0.1 L/min and 24 L.

(e) Reliable quantitation limit: 16 ppb (20 µg/m^3).

(f) Standard error of estimate at the target concentration: 7.3%.

(g) Status of the method: A sampling and analytical method that has been subjected to the established evaluation procedures of the organic methods evaluation branch.

(h) Date: March, 1985.

(13) **General discussion.**

(a) Background: The current WISHA method for collecting acrolein vapor recommends the use of activated 13X molecular sieves. The samples must be stored in an ice bath during and after sampling and also they must be analyzed within forty-eight hours of collection. The current WISHA method for collecting formaldehyde vapor recommends the use of bubblers containing ten percent methanol in water as the trapping solution.

(b) This work was undertaken to resolve the sample stability problems associated with acrolein and also to eliminate the need to use bubblers to sample formaldehyde. A goal of this work was to develop and/or to evaluate a common sampling and analytical procedure for acrolein and formaldehyde.

(c) NIOSH has developed independent methodologies for acrolein and formaldehyde which recommend the use of reagent-coated adsorbent tubes to collect the aldehydes as stable derivatives. The formaldehyde sampling tubes contain Chromosorb 102 adsorbent coated with N-benzylethanolamine (BEA) which reacts with formaldehyde vapor to form a stable oxazolidine compound. The acrolein sampling tubes contain XAD-2 adsorbent coated with 2-(hydroxymethyl) piperidine (2-HMP) which reacts with acrolein vapor to form a different, stable oxazolidine derivative. Acrolein does not appear to react with BEA to give a suitable reaction product. Therefore, the formaldehyde procedure cannot provide a common method for both aldehydes. However, formaldehyde does react with 2-HMP to form a very suitable reaction product. It is the quantitative reaction of acrolein and formaldehyde with 2-HMP that provides the basis for this evaluation.

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(d) This sampling and analytical procedure is very similar to the method recommended by NIOSH for acrolein. Some changes in the NIOSH methodology were necessary to permit the simultaneous determination of both aldehydes and also to accommodate WISHA laboratory equipment and analytical techniques.

(14) **Limit-defining parameters:** The analyte air concentrations reported in this method are based on the recommended air volume for each analyte collected separately and a desorption volume of 1 mL. The amounts are presented as acrolein and/or formaldehyde, even though the derivatives are the actual species analyzed.

(15) **Detection limits of the analytical procedure:** The detection limit of the analytical procedure was 386 pg per injection for formaldehyde. This was the amount of analyte which gave a peak whose height was about five times the height of the peak given by the residual formaldehyde derivative in a typical blank front section of the recommended sampling tube.

(16) **Detection limits of the overall procedure:** The detection limits of the overall procedure were 482 ng per sample (16 ppb or 20 µg/m^3 for formaldehyde). This was the amount of analyte spiked on the sampling device which allowed recoveries approximately equal to the detection limit of the analytical procedure.

(17) **Reliable quantitation limits:**

(a) The reliable quantitation limit was 482 ng per sample (16 ppb or 20 µg/m^3) for formaldehyde. These were the smallest amounts of analyte which could be quantitated within the limits of a recovery of at least seventy-five percent and a precision (±1.96 SD) of ±25% or better.

(b) The reliable quantitation limit and detection limits reported in the method are based upon optimization of the instrument for the smallest possible amount of analyte. When the target concentration of an analyte is exceptionally higher than these limits, they may not be attainable at the routine operating parameters.

(18) **Sensitivity:** The sensitivity of the analytical procedure over concentration ranges representing 0.4 to 2 times the target concentration, based on the recommended air volumes, was seven thousand five hundred eighty-nine area units per µg/mL for formaldehyde. This value was determined from the slope of the calibration curve. The sensitivity may vary with the particular instrument used in the analysis.

(19) **Recovery:** The recovery of formaldehyde from samples used in an eighteen-day storage test remained above ninety-two percent when the samples were stored at ambient temperature. These values were determined from regression lines which were calculated from the storage data. The recovery of the analyte from the collection device must be at least seventy-five percent following storage.

(20) **Precision (analytical method only):** The pooled coefficient of variation obtained from replicate determinations of analytical standards over the range of 0.4 to 2 times the target concentration was 0.0052 for formaldehyde ((d)(C)(iii) of this subsection).

(21) **Precision (overall procedure):** The precision at the ninety-five percent confidence level for the ambient temperature storage tests was ±14.3% for formaldehyde. These values each include an additional ±5% for sampling error. The overall procedure must provide results at the target concentrations that are ±25% at the ninety-five percent confidence level.

(22) **Reproducibility:** Samples collected from controlled test atmospheres and a draft copy of this procedure were given to a chemist unassociated with this evaluation. The formaldehyde samples were analyzed following fifteen days storage. The average recovery was 96.3% and the standard deviation was 1.7%.

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(23) **Advantages:**

(a) The sampling and analytical procedures permit the simultaneous determination of acrolein and formaldehyde.

(b) Samples are stable following storage at ambient temperature for at least eighteen days.

(24) **Disadvantages:** None.

(25) **Sampling procedure.**

(a) Apparatus:

(i) Samples are collected by use of a personal sampling pump that can be calibrated to within ±5% of the recommended 0.1 L/min sampling rate with the sampling tube in line.

(ii) Samples are collected with laboratory prepared sampling tubes. The sampling tube is constructed of silane treated glass and is about 8-cm long. The ID is 4 mm and the OD is 6 mm. One end of the tube is tapered so that a glass wool end plug will hold the contents of the tube in place during sampling. The other end of the sampling tube is open to its full 4-mm ID to facilitate packing of the tube. Both ends of the tube are fire-polished for safety.

The tube is packed with a 75-mg backup section, located nearest the tapered end and a 150-mg sampling section of pretreated XAD-2 adsorbent which has been coated with 2-HMP. The two sections of coated adsorbent are separated and retained with small plugs of silanized glass wool. Following packing, the sampling tubes are sealed with two 7/32 inch OD plastic and caps. Instructions for the pretreatment and the coating of XAD-2 adsorbent are presented in (d) of this subsection.

(b) Sampling tubes, similar to those recommended in this method, are marketed by Supelco, Inc. These tubes were not available when this work was initiated; therefore, they were not evaluated.

(26) **Reagents:** None required.

(27) **Technique:**

(a) Properly label the sampling tube before sampling and then remove the plastic end caps.

(b) Attach the sampling tube to the pump using a section of flexible plastic tubing such that the large, front section of the sampling tube is exposed directly to the atmosphere. Do not place any tubing ahead of the sampling tube. The sampling tube should be attached in the worker's breathing zone in a vertical manner such that it does not impede work performance.

(c) After sampling for the appropriate time, remove the sampling tube from the pump and then seal the tube with plastic end caps.

(d) Include at least one blank for each sampling set. The blank should be handled in the same manner as the samples with the exception that air is not drawn through it.

(e) List any potential interferences on the sample data sheet.

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(28) **Breakthrough:**

(a) Breakthrough was defined as the relative amount of analyte found on a backup sample in relation to the total amount of analyte collected on the sampling train.

(b) For formaldehyde collected from test atmospheres containing six times the PEL, the average five percent breakthrough air volume was 41 L. The sampling rate was 0.1 L/min and the average mass of formaldehyde collected was 250 μg.

(29) **Desorption efficiency:** No desorption efficiency corrections are necessary to compute air sample results because analytical standards are prepared using coated adsorbent. Desorption efficiencies were determined, however, to investigate the recoveries of the analytes from the sampling device. The average recovery over the range of 0.4 to 2 times the target concentration, based on the recommended air volumes, was 96.2% for formaldehyde. Desorption efficiencies were essentially constant over the ranges studied.

(30) **Recommended air volume and sampling rate:**

(a) The recommended air volume for formaldehyde is 24 L.

(b) The recommended sampling rate is 0.1 L/min.

(31) **Interferences:**

(a) Any collected substance that is capable of reacting with 2-HMP and thereby depleting the derivatizing agent is a potential interference. Chemicals which contain a carbonyl group, such as acetone, may be capable of reacting with 2-HMP.

(b) There are no other known interferences to the sampling method.

(32) **Safety precautions:**

(a) Attach the sampling equipment to the worker in such a manner that it will not interfere with work performance or safety.

(b) Follow all safety practices that apply to the work area being sampled.

(33) **Analytical procedure.**

(a) Apparatus:

(i) A gas chromatograph (GC), equipped with a nitrogen selective detector. A Hewlett-Packard model 5840A GC fitted with a nitrogen phosphorus flame ionization detector (NPD) was used for this evaluation. Injections were performed using a Hewlett-Packard model 7671A automatic sampler.

(ii) A GC column capable of resolving the analytes from any interference. A 6 ft x 1/4 in OD (2mm ID) glass GC column containing 10% UCON 50-HB-5100 + 2% KOH on 80/100 mesh Chromosorb W-AW was used for the evaluation. Injections were performed on-column.

(iii) Vials, glass 2-mL with Teflon-lined caps.

(iv) Volumetric flasks, pipets, and syringes for preparing standards, making dilutions, and performing injections.

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(b) Reagents:

(i) Toluene and dimethylformamide. Burdick and Jackson solvents were used in this evaluation.

(ii) Helium, hydrogen, and air, GC grade.

(iii) Formaldehyde, thirty-seven percent by weight, in water. Aldrich Chemical, ACS Reagent Grade formaldehyde was used in this evaluation.

(iv) Amberlite XAD-2 adsorbent coated with 2-(hydroxymethyl) piperidine (2-HMP), 10% by weight ((d) of this subsection).

(v) Desorbing solution with internal standard. This solution was prepared by adding 20 uL of dimethylformamide to 100 mL of toluene.

(c) Standard preparation:

(i) Formaldehyde: Prepare stock standards by diluting known volumes of thirty-seven percent formaldehyde solution with methanol. A procedure to determine the formaldehyde content of these standards is presented in (d) of this subsection. A standard containing 7.7 mg/mL formaldehyde was prepared by diluting 1 mL of the thirty-seven percent reagent to 50 mL with methanol.

(ii) It is recommended that analytical standards be prepared about sixteen hours before the air samples are to be analyzed in order to ensure the complete reaction of the analytes with 2-HMP. However, rate studies have shown the reaction to be greater than ninety-five percent complete after four hours. Therefore, one or two standards can be analyzed after this reduced time if sample results are outside the concentration range of the prepared standards.

(iii) Place 150-mg portions of coated XAD-2 adsorbent, from the same lot number as used to collect the air samples, into each of several glass 2-mL vials. Seal each vial with a Teflon-lined cap.

(iv) Prepare fresh analytical standards each day by injecting appropriate amounts of the diluted analyte directly onto 150-mg portions of coated adsorbent. It is permissible to inject both acrolein and formaldehyde on the same adsorbent portion. Allow the standards to stand at room temperature. A standard, approximately the target levels, was prepared by injecting 11 uL of the acrolein and 12 uL of the formaldehyde stock standards onto a single coated XAD-2 adsorbent portion.

(v) Prepare a sufficient number of standards to generate the calibration curves. Analytical standard concentrations should bracket sample concentrations. Thus, if samples are not in the concentration range of the prepared standards, additional standards must be prepared to determine detector response.

(vi) Desorb the standards in the same manner as the samples following the sixteen-hour reaction time.

(d) Sample preparation:

(i) Transfer the 150-mg section of the sampling tube to a 2-mL vial. Place the 75-mg section in a separate vial. If the glass wool plugs contain a significant number of

adsorbent beads, place them with the appropriate sampling tube section. Discard the glass wool plugs if they do not contain a significant number of adsorbent beads.

(ii) Add 1 mL of desorbing solution to each vial.

(iii) Seal the vials with Teflon-lined caps and then allow them to desorb for one hour. Shake the vials by hand with vigorous force several times during the desorption time.

(iv) Save the used sampling tubes to be cleaned and recycled.

(e) Analysis:

(f) GC conditions.

(34) **Column temperature:**

(a) Bi-level temperature program.

(i) First level: 100°C to 140C at 4°C/min following completion of the first level.

(ii) Second level: 140°C to 180°C at 20°C/min following completion of the first level.

(b) Isothermal period: Hold column at 180°C until the recorder pen returns to baseline (usually about twenty-five minutes after injection).

(c) Injector temperature: 180°C.

(d) Helium flow rate: 30 mL/min (detector response will be reduced if nitrogen is substituted for helium carrier gas).

(e) Injection volume: 51 0.8 uL.

(f) GC column: Six-ft x 1/4-in OD (2 mm ID) glass GC column containing 10% UCON 50-HB-5100NZG651+512% KOH on 80/100 Chromosorb W-AW.

(g) NPD conditions:

(i) Hydrogen flow rate: 3 mL/min.

(ii) Air flow rate: 50 mL/min.

(h) Detector temperature: 275 5151C.

(i) Use a suitable method, such as electronic integration, to measure detector response.

(ii) Use an internal standard method to prepare the calibration curve with several standard solutions of different concentrations. Prepare the calibration curve daily. Program the integrator to report results in µg/mL.

(iii) Bracket sample concentrations with standards.

(iv) Interferences (analytical).

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(A) Any compound with the same general retention time as the analytes and which also gives a detector response is a potential interference. Possible interferences should be reported to the laboratory with submitted samples by the industrial hygienist.

(B) GC parameters (temperature, column, etc.), may be changed to circumvent interferences.

(C) A useful means of structure designation is GC/MS. It is recommended this procedure be used to confirm samples whenever possible.

(D) The coated adsorbent usually contains a very small amount of residual formaldehyde derivative.

(i) Calculations:

(i) Results are obtained by use of calibration curves. Calibration curves are prepared by plotting detector response against concentration for each standard. The best line through the data points is determined by curve fitting.

(ii) The concentration, in µg/mL, for a particular sample is determined by comparing its detector response to the calibration curve. If either of the analytes is found on the backup section, it is added to the amount found on the front section. Blank corrections should be performed before adding the results together.

(iii) The acrolein and/or formaldehyde air concentration can be expressed using the following equation:

$Mg/m^3 = (A)(B)/C.$

where A = µg/mL from 3.7.2, B = desorption volume, and C = L of air sampled.

No desorption efficiency corrections are required.

(iv) The following equation can be used to convert results in mg/m51351 to ppm.

$ppm = (mg/m^3)(24.45)/MW$

where mg/m^3 = result from 3.7.3, 24.45 = molar volume of an ideal gas at 760 mm Hg and 25 5151C, MW = molecular weight (Formaldehyde = 30.0).

(j) Backup data. Backup data on detection limits, reliable quantitation limits, sensitivity and precision of the analytical method, breakthrough, desorption efficiency, storage, reproducibility, and generation of test atmospheres are available in OSHA Method 52, developed by the Organics Methods Evaluation Branch, OSHA Analytical Laboratory, Salt Lake City, Utah.

(k) Procedure to coat XAD-2 adsorbent with 2-HMP:

(i) Apparatus: Soxhlet extraction apparatus, rotary evaporation apparatus, vacuum dessicator, 1-L vacuum flask, 1-L round-bottomed evaporative flask, 1-L Erlenmeyer flask, 250-mL Buchner funnel with a coarse fritted disc, etc.

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(ii) Reagents:

(A) Methanol, isooctane, and toluene.

(B) (Hydroxymethyl) piperidine.

(C) Amberlite XAD-2 nonionic polymeric adsorbent, twenty to sixty mesh, Aldrich Chemical XAD-2 was used in this evaluation.

(l) Procedure: Weigh 125 g of crude XAD-2 adsorbent into a 1-L Erlenmeyer flask. Add about 200 mL of water to the flask and then swirl the mixture to wash the adsorbent. Discard any adsorbent that floats to the top of the water and then filter the mixture using a fritted Buchner funnel. Air dry the adsorbent for two minutes. Transfer the adsorbent back to the Erlenmeyer flask and then add about 200 mL of methanol to the flask. Swirl and then filter the mixture as before. Transfer the washed adsorbent back to the Erlenmeyer flask and then add about 200 mL of methanol to the flask. Swirl and then filter the mixture as before. Transfer the washed adsorbent to a 1-L round-bottomed evaporative flask, add 13 g of 2-HMP and then 200 mL of methanol, swirl the mixture and then allow it to stand for one hour. Remove the methanol at about 40^{O}C and reduced pressure using a rotary evaporation apparatus. Transfer the coated adsorbent to a suitable container and store it in a vacuum desiccator at room temperature overnight. Transfer the coated adsorbent to a Soxhlet extractor and then extract the material with toluene for about twenty-four hours. Discard the contaminated toluene, add methanol in its place and then continue the Soxhlet extraction for an additional four hours. Transfer the adsorbent to a weighted 1-L round-bottom evaporative flask and remove the methanol using the rotary evaporation apparatus. Determine the weight of the adsorbent and then add an amount of 2-HMP, which is ten percent by weight of the adsorbent. Add 200 mL of methanol and then swirl the mixture. Allow the mixture to stand for one hour. Remove the methanol by rotary evaporation. Transfer the coated adsorbent to a suitable container and store it in a vacuum dessicator until all traces of solvents are gone. Typically, this will take two to three days. The coated adsorbent should be protected from contamination. XAD-2 adsorbent treated in this manner will probably not contain residual acrolein derivative. However, this adsorbent will often contain residual formaldehyde derivative levels of about 0.1 μg per 150 mg of adsorbent. If the blank values for a batch of coated adsorbent are too high, then the batch should be returned to the Soxhlet extractor, extracted with toluene again and then recoated. This process can be repeated until the desired blank levels are attained.

The coated adsorbent is now ready to be packed into sampling tubes. The sampling tubes should be stored in a sealed container to prevent contamination. Sampling tubes should be stored in the dark at room temperature. The sampling tubes should be segregated by coated adsorbent lot number. A sufficient amount of each lot number of coated adsorbent should be retained to prepare analytical standards for use with air samples from that lot number.

(m) A procedure to determine formaldehyde by acid titration:

(i) Standardize the 0.1 N HC1 solution using sodium carbonate and methyl orange indicator.

(ii) Place 50 mL of 0.1 M sodium sulfite and three drops of thymophthalein indicator into a 250-mL Erlenmeyer flask. Titrate the contents of the flask to a colorless endpoint with 0.1 N HC1 (usually one or two drops is sufficient). Transfer 10 mL of the formaldehyde/methanol solution ((b)(iii)(A) of this subsection) into the same flask and titrate the mixture with 0.1 N HC1, again, to a colorless endpoint. The formaldehyde concentration of the standard may be calculated by the following equation:

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$$\text{Formaldehyde, mg/mL} = \frac{\text{acid titer x acid normality x 30.0}}{\text{mL of Sample}}$$

(iii) This method is based on the quantitative liberation of sodium hydroxide when formaldehyde reacts with sodium sulfite to form the formaldehyde-bisulfite addition product. The volume of sample may be varied depending on the formaldehyde content but the solution to be titrated must contain excess sodium sulfite. Formaldehyde solutions containing substantial amounts of acid or base must be neutralized before analysis.

[Statutory Authority: Chapter 49.17 RCW. 91-11-070 (Order 91-01), 296-62-07544, filed 5/20/91, effective 6/20/91; 90-03-029 (Order 89-20), 296-62-07544, filed 1/11/90, effective 2/26/90; 89-11-035 (Order 89-03), 296-62-07544, filed 5/15/89, effective 6/30/89; 88-21-002 (Order 88-23), 296-62-07544, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07546 Appendix C medical surveillance--Formaldehyde.

(1) **Health hazards.** The occupational health hazards of formaldehyde are primarily due to its toxic effects after inhalation, after direct contact with the skin or eyes by formaldehyde in liquid or vapor form, and after ingestion.

(2) **Toxicology.**

(a) Acute effects of exposure.

(i) Inhalation (breathing): Formaldehyde is highly irritating to the upper airways. The concentration of formaldehyde that is immediately dangerous to life and health is 100 ppm. Concentrations above 50 ppm can cause severe pulmonary reactions within minutes. These include pulmonary edema, pneumonia, and bronchial irritation which can result in death. Concentrations above 5 ppm readily cause lower airway irritation characterized by cough, chest tightness, and wheezing. There is some controversy regarding whether formaldehyde gas is a pulmonary sensitizer which can cause occupational asthma in a previously normal individual. Formaldehyde can produce symptoms of bronchial asthma in humans. The mechanism may be either sensitization of the individual by exposure to formaldehyde or direct irritation by formaldehyde in persons with preexisting asthma. Upper airway irritation is the most common respiratory effect reported by workers and can occur over a wide range of concentrations, most frequently above 1 ppm. However, airway irritation has occurred in some workers with exposures to formaldehyde as low as 0.1 ppm. Symptoms of upper airway irritation include dry or sore throat, itching and burning sensations of the nose, and nasal congestion. Tolerance to this level of exposure may develop within one to two hours. This tolerance can permit workers remaining in an environment of gradually increasing formaldehyde concentrations to be unaware of their increasingly hazardous exposure.

(ii) Eye contact: Concentrations of formaldehyde between 0.05 ppm and 0.5 ppm produce a sensation of irritation in the eyes with burning, itching, redness, and tearing. Increased rate of blinking and eye closure generally protects the eye from damage at these low levels, but these protective mechanisms may interfere with some workers' work abilities. Tolerance can occur in workers continuously exposed to concentrations of formaldehyde in this range. Accidental splash injuries of human eyes to aqueous solutions of formaldehyde (formalin) have resulted in a wide range of ocular injuries including corneal opacities and blindness. The severity of the reactions have been directly dependent on the concentration of formaldehyde in solution and the amount of time lapsed before emergency and medical intervention.

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(iii) Skin contact: Exposure to formaldehyde solutions can cause irritation of the skin and allergic contact dermatitis. These skin diseases and disorders can occur at levels well below those encountered by many formaldehyde workers. Symptoms include erythema, edema, and vesiculation or hives. Exposure to liquid formalin or formaldehyde vapor can provoke skin reactions in sensitized individuals even when airborne concentrations of formaldehyde are well below 1 ppm.

(iv) Ingestion: Ingestion of as little as 30 ml of a thirty-seven percent solution of formaldehyde (formalin) can result in death. Gastrointestinal toxicity after ingestion is most severe in the stomach and results in symptoms which can include nausea, vomiting, and severe abdominal pain. Diverse damage to other organ systems including the liver, kidney, spleen, pancreas, brain, and central nervous systems can occur from the acute response to ingestion of formaldehyde.

(b) Chronic effects of exposure. Long-term exposure to formaldehyde has been shown to be associated with an increased risk of cancer of the nose and accessory sinuses, nasopharyngeal and oropharyngeal cancer, and lung cancer in humans. Animal experiments provide conclusive evidence of a causal relationship between nasal cancer in rats and formaldehyde exposure. Concordant evidence of carcinogenicity includes DNA binding, genotoxicity in short-term tests, and cytotoxic changes in the cells of the target organ suggesting both preneoplastic changes and a dose-rate effect. Formaldehyde is a complete carcinogen and appears to exert an effect on at least two stages of the carcinogenic process.

(3) **Surveillance considerations.**

(a) History.

(i) Medical and occupational history: Along with its acute irritative effects, formaldehyde can cause allergic sensitization and cancer. One of the goals of the work history should be to elicit information on any prior or additional exposure to formaldehyde in either the occupational or the nonoccupational setting.

(ii) Respiratory history: As noted above, formaldehyde has recognized properties as an airway irritant and has been reported by some authors as a cause of occupational asthma. In addition, formaldehyde has been associated with cancer of the entire respiratory system of humans. For these reasons, it is appropriate to include a comprehensive review of the respiratory system in the medical history. Components of this history might include questions regarding dyspnea on exertion, shortness of breath, chronic airway complaints, hyperreactive airway disease, rhinitis, bronchitis, bronchiolitis, asthma, emphysema, respiratory allergic reaction, or other preexisting pulmonary disease.

In addition, generalized airway hypersensitivity can result from exposures to a single sensitizing agent. The examiner should, therefore, elicit any prior history of exposure to pulmonary irritants, and any short-term or long-term effects of that exposure.

Smoking is known to decrease mucociliary clearance of materials deposited during respiration in the nose and upper airways. This may increase a worker's exposure to inhaled materials such as formaldehyde vapor. In addition, smoking is a potential confounding factor in the investigation of any chronic respiratory disease, including cancer. For these reasons, a complete smoking history should be obtained.

(iii) Skin disorders: Because of the dermal irritant and sensitizing effects of formaldehyde, a history of skin disorders should be obtained. Such a history might include the existence

of skin irritation, previously documented skin sensitivity, and other dermatologic disorders. Previous exposure to formaldehyde and other dermal sensitizers should be recorded.

(iv) History of atopic or allergic diseases: Since formaldehyde can cause allergic sensitization of the skin and airways, it might be useful to identify individuals with prior allergen sensitization. A history of atopic disease and allergies to formaldehyde or any other substances should also be obtained. It is not definitely known at this time whether atopic diseases and allergies to formaldehyde or any other substances should also be obtained. Also it is not definitely known at this time whether atopic individuals have a greater propensity to develop formaldehyde sensitivity than the general population, but identification of these individuals may be useful for ongoing surveillance.

(v) Use of disease questionnaires: Comparison of the results from previous years with present results provides the best method for detecting a general deterioration in health when toxic signs and symptoms are measured subjectively. In this way recall bias does not affect the results of the analysis. Consequently, WISHA has determined that the findings of the medical and work histories should be kept in a standardized form for comparison of the year-to-year results.

(b) Physical examination.

(i) Mucosa of eyes and airways: Because of the irritant effects of formaldehyde, the examining physician should be alert to evidence of this irritation. A speculum examination of the nasal mucosa may be helpful in assessing possible irritation and cytotoxic changes, as may be indirect inspection of the posterior pharynx by mirror.

(ii) Pulmonary system: A conventional respiratory examination, including inspection of the thorax and auscultation and percussion of the lung fields should be performed as part of the periodic medical examination. Although routine pulmonary function testing is only required by the standard once every year for persons who are exposed over the TWA concentration limit, these tests have an obvious value in investigating possible respiratory dysfunction and should be used wherever deemed appropriate by the physician. In cases of alleged formaldehyde-induced airway disease, other possible causes of pulmonary dysfunction (including exposures to other substances) should be ruled out. A chest radiograph may be useful in these circumstances. In cases of suspected airway hypersensitivity or allergy, it may be appropriate to use bronchial challenge testing with formaldehyde or methacholine to determine the nature of the disorder. Such testing should be performed by or under the supervision of a physician experienced in the procedures involved.

(iii) Skin: The physician should be alert to evidence of dermal irritation of sensitization, including reddening and inflammation, urticaria, blistering, scaling, formation of skin fissures, or other symptoms. Since the integrity of the skin barrier is compromised by other dermal diseases, the presence of such disease should be noted. Skin sensitivity testing carries with it some risk of inducing sensitivity, and therefore, skin testing for formaldehyde sensitivity should not be used as a routine screening test. Sensitivity testing may be indicated in the investigation of a suspected existing sensitivity. Guidelines for such testing have been prepared by the North American Contact Dermatitis Group.

(4) **Additional examinations or tests.** The physician may deem it necessary to perform other medical examinations or tests as indicated. The standard provides a mechanism whereby these additional investigations are covered under the standard for occupational exposure to formaldehyde.

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(5) **Emergencies.** The examination of workers exposed in an emergency should be directed at the organ systems most likely to be affected. Much of the content of the examination will be similar to the periodic examination unless the patient has received a severe acute exposure requiring immediate attention to prevent serious consequences. If a severe overexposure requiring medical intervention or hospitalization has occurred, the physician must be alert to the possibility of delayed symptoms. Followup nonroutine examinations may be necessary to assure the patient's well-being.

(6) **Employer obligations.** The employer is required to provide the physician with the following information: A copy of this standard and appendices A, C, D, and E; a description of the affected employee's duties as they relate to his or her exposure concentration; an estimate of the employee's exposure including duration (e.g., fifteen hr./wk., three eight-hour shifts, full-time); a description of any personal protective equipment, including respirators, used by the employee; and the results of any previous medical determinations for the affected employee related to formaldehyde exposure to the extent that this information is within the employer's control.

(7) **Physician's obligations.** The standard requires the employer to obtain a written statement from the physician. This statement must contain the physician's opinion as to whether the employee has any medical condition which would place him or her at increased risk of impaired health from exposure to formaldehyde or use of respirators, as appropriate. The physician must also state his opinion regarding any restrictions that should be placed on the employee's exposure to formaldehyde or upon the use of protective clothing or equipment such as respirators. If the employee wears a respirator as a result of his or her exposure to formaldehyde, the physician's opinion must also contain a statement regarding the suitability of the employee to wear the type of respirator assigned. Finally, the physician must inform the employer that the employee has been told the results of the medical examination and of any medical conditions which require further explanation or treatment. This written opinion is not to contain any information on specific findings or diagnoses unrelated to occupational exposure to formaldehyde.

The purpose in requiring the examining physician to supply the employer with a written opinion is to provide the employer with a medical basis to assist the employer in placing employees initially, in assuring that their health is not being impaired by formaldehyde, and to assess the employee's ability to use any required protective equipment.

[Statutory Authority: Chapter 49.17 RCW. 88-21-002 (Order 88-23), 296-62-07546, filed 10/6/88, effective 11/7/88.]

WAC 296-62-07548 Appendix D--Nonmandatory medical disease questionnaire.

(1) **Identification.**
- (a) Plant name:
- (b) Date:
- (c) Employee name:
- (d) Social Security number:
- (e) Job title:
- (f) Birthdate:
- (g) Age:
- (h) Sex:
- (i) Height:
- (j) Weight:

(2) **Medical history.**
- (a) Have you ever been in the hospital as a patient?
  Yes No
  If yes, what kind of problem were you having?
- (b) Have you ever had any kind of operation?
  Yes No
  If yes, what kind?

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(c) Do you take any kind of medicine regularly?
Yes No
If yes, what kind?
(d) Are you allergic to any drugs, foods, or chemicals?
Yes No
If yes, what kind of allergy is it?
What causes the allergy?
(e) Have you ever been told that you have asthma, hayfever, or sinusitis?
Yes No
(f) Have you ever been told that you have emphysema, bronchitis, or any other respiratory problems?
Yes No
(g) Have you ever been told you had hepatitis?
Yes No
(h) Have you ever been told that you have cirrhosis?
Yes No
(i) Have you ever been told that you had cancer?
Yes No
(j) Have you ever had arthritis or joint pain?
Yes No
(k) Have you ever been told that you had high blood pressure?
Yes No
(l) Have you ever had a heart attack or heart trouble?
Yes No

(3) **Medical history update.**
(a) Have you been in the hospital as a patient any time within the past year?
Yes No
If so, for what condition?
(b) Have you been under the care of a physician during the past year?
Yes No
If so, for what condition?
(c) Is there any change in your breathing since last year?
Yes No
(i) Better?
(ii) Worse?
(iii) No change?
If change, do you know why?
(d) Is your general health different this year from last year?
Yes No
If different, in what way?
(e) Have you in the past year or are you now taking any medication on a regular basis?
Yes No
(i) Name Rx
(ii) Condition being treated

(4) **Occupational history.**
(a) How long have you worked for your present employer?
(b) What jobs have you held with this employer? Include job title and length of time in each job.
(c) In each of these jobs, how many hours a day were you exposed to chemicals?
(d) What chemicals have you worked with most of the time?
(e) Have you ever noticed any type of skin rash you feel was related to your work?
Yes No
(f) Have you ever noticed that any kind of chemical makes you cough?
Yes No
(i) Wheeze:

Yes No

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(ii) Become short of breath or cause your chest to become tight?
Yes No

(g) Are you exposed to any dust or chemicals at home?
Yes No
If yes, explain:

(h) In other jobs, have you ever had exposure to:

(i) Wood dust?
Yes No

(ii) Nickel or chromium?
Yes No

(iii) Silica (foundry, sand blasting)?
Yes No

(iv) Arsenic or asbestos?
Yes No

(v) Organic solvents?
Yes No

(vi) Urethane foams?
Yes No

(5) **Occupational history update.**

(a) Are you working on the same job this year as you were last year?
Yes No
If not, how has your job changed?

(b) What chemicals are you exposed to on your job?

(c) How many hours a day are you exposed to chemicals?

(d) Have you noticed any skin rash within the past year you feel was related to your work?
Yes No
If so, explain circumstances:

(e) Have you noticed that any chemical makes you cough, be short of breath, or wheeze?
Yes No
If so, can you identify it?

(6) **Miscellaneous.**

(a) Do you smoke?
Yes No
If so, how much and for how long?
(i) Pipe(ii) Cigars(iii) Cigarettes

(b) Do you drink alcohol in any form?
Yes No
If so, how much, how long, and how often?

(c) Do you wear glasses or contact lenses?
Yes No

(d) Do you get any physical exercise other than that required to do your job?
Yes No
If so, explain:

(e) Do you have any hobbies or "side jobs" that require you to use chemicals, such as furniture stripping, sand blasting, insulation or manufacture of urethane foam, furniture, etc.?
Yes No
If so, please describe, giving type of business or hobby, chemicals used and length of exposures.

(7) **Symptoms questionnaire.**

(a) Do you ever have any shortness of breath?
Yes No

(i) If yes, do you have to rest after climbing several flights of stairs?
Yes No

WAC 296-62-07548 (Cont.)

(ii) If yes, if you walk on the level with people your own age, do you walk slower than they do?
Yes No

(iii) If yes, if you walk slower than a normal pace, do you have to limit the distance that you walk?
Yes No

(iv) If yes, do you have to stop and rest while bathing or dressing?
Yes No

(b) Do you cough as much as three months out of the year?
Yes No

(i) If yes, have you had this cough for more than two years?
Yes No

(ii) If yes, do you ever cough anything up from the chest?
Yes No

(c) Do you ever have a feeling of smothering, unable to take a deep breath, or tightness in your chest?
Yes No

(i) If yes, do you notice that this occurs on any particular day of the week?
Yes No

(ii) If yes, what day of the week?

(iii) If yes, do you notice that this occurs at any particular place?
Yes No

(iv) If yes, do you notice that this is worse after you have returned to work after being off for several days?
Yes No

(d) Have you ever noticed any wheezing in your chest?
Yes No

(i) If yes, is this only with colds or other infections?
Yes No

(ii) Is this caused by exposure to any kind of dust or other material?
Yes No

(iii) If yes, what kind?

(e) Have you noticed any burning, tearing, or redness of your eyes when you are at work?
Yes No
If so, explain circumstances:

(f) Have you noticed any sore or burning throat or itchy or burning nose when you are at work?
Yes No
If so, explain circumstances:

(g) Have you noticed any stuffiness or dryness of your nose?
Yes No

(h) Do you ever have swelling of the eyelids or face?
Yes No

(i) Have you ever been jaundiced?
Yes No
If yes, was this accompanied by any pain?
Yes No

(j) Have you ever had a tendency to bruise easily or bleed excessively?
Yes No

(k) Do you have frequent headaches that are not relieved by aspirin or tylenol?
Yes No

(i) If yes, do they occur at any particular time of the day or week?
Yes No

(ii) If yes, when do they occur?

(l) Do you have frequent episodes of nervousness or irritability?
Yes No

WAC 296-62-07548 (Cont.)

(m) Do you tend to have trouble concentrating or remembering?
Yes No

(n) Do you ever feel dizzy, light-headed, excessively drowsy, or like you have been drugged?
Yes No

(o) Does your vision ever become blurred?
Yes No

(p) Do you have numbness or tingling of the hands or feet or other parts of your body?
Yes No

(q) Have you ever had chronic weakness or fatigue?
Yes No

(r) Have you every had any swelling of your feet or ankles to the point where you could not wear your shoes?
Yes No

(s) Are you bothered by heartburn or indigestion?
Yes No

(t) Do you ever have itching, dryness, or peeling and scaling of the hands?
Yes No

(u) Do you ever have a burning sensation in the hands, or reddening of the skin?
Yes No

(v) Do you ever have cracking or bleeding of the skin on your hands?
Yes No

(w) Are you under a physician's care?
Yes No
If yes, for what are you being treated?

(x) Do you have any physical complaints today?
Yes No
If yes, explain:

(y) Do you have other health conditions not covered by these questions?
Yes No
If yes, explain:

[Statutory Authority: Chapter 49.17 RCW. 88-21-002 (Order 88-23), § 296-62-07548, filed 10/6/88, effective 11/7/88.]

WAC 296-62-076 Methylenedianiline.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-076, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07601 Scope and application.

(1) WAC 296-62-076 applies to all occupational exposures to MDA, Chemical Abstracts Service Registry No. 101-77-9, except as provided in subsections (2) through (7) of this section.

(2) Except as provided in subsection (8) of this section and WAC 296-62-07609(5), this section does not apply to the processing, use, and handling of products containing MDA where initial monitoring indicates that the product is not capable of releasing MDA in excess of the action level under the expected conditions of processing, use, and handling which will cause the greatest possible release; and where no “dermal exposure to MDA” can occur.

(3) Except as provided in subsection (8) of this section, WAC 296-62-076 does not apply to the processing, use, and handling of products containing MDA where objective data are reasonably relied upon which demonstrate the product is not capable of releasing MDA under the expected conditions of processing, use, and handling which will cause the greatest possible release; and where no “dermal exposure to MDA” can occur.

(4) WAC 296-62-076 does not apply to the storage, transportation, distribution, or sale of MDA in intact containers sealed in such a manner as to contain the MDA dusts, vapors, or liquids, except for the provisions of WAC 296-62-054, 296-62-07607 and 296-800-170.

WAC 296-62-07601 (Cont.)

(5) WAC 296-62-076 does not apply to the construction industry as defined in WAC 296-155-012(6). (Exposure to MDA in the construction industry is covered by WAC 296-155-173.)

(6) Except as provided in subsection (8) of this section, WAC 296-62-076 does not apply to materials in any form which contain less than 0.1% MDA by weight or volume.

(7) Except as provided in subsection (8) of this section, WAC 296-62-076 does not apply to "finished articles containing MDA."

(8) Where products containing MDA are exempted under subsections (2) through (7) of this section, the employer shall maintain records of the initial monitoring results or objective data supporting that exemption and the basis for the employer's reliance on the data, as provided in the recordkeeping provision of WAC 296-62-07631.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07601, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07601, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07603 Definitions. For the purpose of WAC 296-62-076, the following definitions shall apply:

(1) **"Action level"** means a concentration of airborne MDA of 5 ppb as an 8-hour time-weighted average.

(2) **"Authorized person"** means any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees, for the purpose of exercising the right to observe monitoring and measuring procedures under WAC 296-62-07633 of WAC 296-62-076, or any other person authorized by WISHA or regulations issued by WISHA.

(3) **"Container"** means any barrel, bottle, can, cylinder, drum, reaction vessel, storage tank, commercial packaging, or the like, but does not include piping systems.

(4) **"Dermal exposure to MDA"** occurs where employees are engaged in the handling, application, or use of mixtures or materials containing MDA, with any of the following nonairborne forms of MDA:

(a) Liquid, powdered, granular, or flaked mixtures containing MDA in concentrations greater than 0.1% by weight or volume; and

(b) Materials other than "finished articles" containing MDA in concentrations greater than 0.1% by weight or volume.

(5) **"Director"** means the director of the department of labor and industries, or his/her designated representative.

(6) **"Emergency"** means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which results in an unexpected and potentially hazardous release of MDA.

(7) **"Employee exposure"** means exposure to MDA which would occur if the employee were not using respirators or protective work clothing and equipment.

(8) **"Finished article containing MDA"** is defined as a manufactured item:

(a) Which is formed to a specific shape or design during manufacture;

(b) Which has end use function(s) dependent in whole or part upon its shape or design during end use; and

WAC 296-62-07603 (Cont.)

(c) Where applicable, is an item which is fully cured by virtue of having been subjected to the conditions (temperature, time) necessary to complete the desired chemical reaction.

(9) **"4,4' methylenedianiline" or "MDA"** means the chemical 4,4'- diaminodiphenylmethane, Chemical Abstract Service Registry number 101-77-9, in the form of a vapor, liquid, or solid. The definition also includes the salts of MDA.

(10) **"Regulated areas"** means areas where airborne concentrations of MDA exceed or can reasonably be expected to exceed, the permissible exposure limits, or where dermal exposure to MDA can occur.

(11) **"STEL"** means short-term exposure limit as determined by any 15 minute sample period.
[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07603, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07605 Permissible exposure limits (PEL). The employer shall assure that no employee is exposed to an airborne concentration of MDA in excess of ten parts per billion (10 ppb) as an 8-hour time-weighted average or a STEL of 100 ppb.
[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07605, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07607 Emergency situations.

(1) **Written plan.**

(a) A written plan for emergency situations shall be developed for each workplace where there is a possibility of an emergency. Appropriate portions of the plan shall be implemented in the event of an emergency.

(b) The plan shall specifically provide that employees engaged in correcting emergency conditions shall be equipped with the appropriate personal protective equipment and clothing as required in WAC 296-62-07615 and 296-62-07617 until the emergency is abated.

(c) The plan shall specifically include provisions for alerting and evacuating affected employees as well as the elements prescribed in chapter 296-24 WAC, Part G-1, "Employee emergency plans and fire prevention plans."

(2) **Alerting employees.** Where there is the possibility of employee exposure to MDA due to an emergency, means shall be developed to alert promptly those employees who have the potential to be directly exposed. Affected employees not engaged in correcting emergency conditions shall be evacuated immediately in the event that an emergency occurs. Means shall also be developed and implemented for alerting other employees who may be exposed as a result of the emergency.
[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07607, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07609 Exposure monitoring.

(1) **General.**

(a) Determinations of employee exposure shall be made from breathing zone air samples that are representative of each employee's exposure to airborne MDA over an 8-hour period. Determination of employee exposure to the STEL shall be made from breathing zone air samples collected over a 15 minute sampling period.

(b) Representative employee exposure shall be determined on the basis of one or more samples representing full shift exposure for each shift for each job classification in each work area where exposure to MDA may occur.

WAC 296-62-07609 (Cont.)

(c) Where the employer can document that exposure levels are equivalent for similar operations in different work shifts, the employer shall only be required to determine representative employee exposure for that operation during one shift.

(2) **Initial monitoring.** Each employer who has a workplace or work operation covered by this standard shall perform initial monitoring to determine accurately the airborne concentrations of MDA to which employees may be exposed.

(3) **Periodic monitoring and monitoring frequency.**

(a) If the monitoring required by subsection (2) of this section reveals employee exposure at or above the action level, but at or below the PELs, the employer shall repeat such representative monitoring for each such employee at least every six months.

(b) If the monitoring required by subsection (2) of this section reveals employee exposure above the PELs, the employer shall repeat such monitoring for each such employee at least every three months.

(c) The employer may alter the monitoring schedule from every three months to every six months for any employee for whom two consecutive measurements taken at least 7 days apart indicate that the employee exposure has decreased to below the TWA but above the action level.

(4) **Termination of monitoring.**

(a) If the initial monitoring required by subsection (2) of this section reveals employee exposure to be below the action level, the employer may discontinue the monitoring for that employee, except as otherwise required by subsection (5) of this section.

(b) If the periodic monitoring required by subsection (3) of this section reveals that employee exposures, as indicated by at least two consecutive measurements taken at least 7 days apart, are below the action level the employer may discontinue the monitoring for that employee, except as otherwise required by subsection (5) of this section.

(5) **Additional monitoring.** The employer shall institute the exposure monitoring required under subsections (2) and (3) of this section when there has been a change in production process, chemicals present, control equipment, personnel, or work practices which may result in new or additional exposures to MDA, or when the employer has any reason to suspect a change which may result in new or additional exposures.

(6) **Accuracy of monitoring.** Monitoring shall be accurate, to a confidence level of 95 percent, to within plus or minus 25 percent for airborne concentrations of MDA.

(7) **Employee notification of monitoring results.**

(a) The employer shall, within 15 working days after the receipt of the results of any monitoring performed under this standard, notify each employee of these results, in writing, either individually or by posting of results in an appropriate location that is accessible to affected employees.

(b) The written notification required by subdivision (a) of this subsection shall contain the corrective action being taken by the employer to reduce the employee exposure to or below the PELs, wherever the PELs are exceeded.

WAC 296-62-07609 (Cont.)

(8) **Visual monitoring.** The employer shall make routine inspections of employee hands, face, and forearms potentially exposed to MDA. Other potential dermal exposures reported by the employee must be referred to the appropriate medical personnel for observation. If the employer determines that the employee has been exposed to MDA the employer shall:

(a) Determine the source of exposure;

(b) Implement protective measures to correct the hazard; and

(c) Maintain records of the corrective actions in accordance with WAC 296-62-07631.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07609, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07611 Regulated areas.

(1) **Establishment.**

(a) Airborne exposures. The employer shall establish regulated areas where airborne concentrations of MDA exceed or can reasonably be expected to exceed, the permissible exposure limits.

(b) Dermal exposures. Where employees are subject to dermal exposure to MDA the employer shall establish those work areas as regulated areas.

(2) **Demarcation.** Regulated areas shall be demarcated from the rest of the workplace in a manner that minimizes the number of persons potentially exposed.

(3) **Access.** Access to regulated areas shall be limited to authorized persons.

(4) **Personal protective equipment and clothing.** Each person entering a regulated area shall be supplied with, and required to use, the appropriate personal protective clothing and equipment in accordance with WAC 296-62-07615 and 296-62-07617.

(5) **Prohibited activities.** The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07611, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07613 Methods of compliance.

(1) **Engineering controls and work practices.**

(a) The employer shall institute engineering controls and work practices to reduce and maintain employee exposure to MDA at or below the PELs except to the extent that the employer can establish that these controls are not feasible or where the provisions of subdivision (b) of this subsection or WAC 296-62-07615(1) apply.

(b) Wherever the feasible engineering controls and work practices which can be instituted are not sufficient to reduce employee exposure to or below the PELs, the employer shall use them to reduce employee exposure to the lowest levels achievable by these controls and shall supplement them by the use of respiratory protective devices which comply with the requirements of WAC 296-62-07615.

WAC 296-62-07613 (Cont.)

(2) **Compliance program.**

(a) The employer shall establish and implement a written program to reduce employee exposure to or below the PELs by means of engineering and work practice controls, as required by subsection (1) of this section, and by use of respiratory protection where permitted under WAC 296-62-076. The program shall include a schedule for periodic maintenance (e.g., leak detection) and shall include the written plan for emergency situations as specified in WAC 296-62-07607.

(b) Upon request this written program shall be furnished for examination and copying to the director, affected employees, and designated employee representatives. The employer shall review and, as necessary, update such plans at least once every 12 months to make certain they reflect the current status of the program.

(3) **Employee rotation.** Employee rotation shall not be permitted as a means of reducing exposure.
[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07613, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07615 Respiratory protection.

(1) **General.** For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this subsection. Respirators must be used during:

(a) Periods necessary to install or implement feasible engineering and work-practice controls;

(b) Work operations for which the employer establishes that engineering and work-practice controls are not feasible;

(c) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce exposure to or below the PEL;

(d) Emergencies.

(2) **Respirator program.** The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(3) **Respirator selection.**

(a) The employer must select, and ensure that employees use, the appropriate respirator from Table 1 of this section.

WAC 296-62-07615 (Cont.)

Table 1.--Respiratory Protection for MDA

Airborne concentration of MDA or condition of use		Respirator type	
a.	Less than or equal to 10xPEL	(1)	Half-mask respirator with HEPA1 cartridge[2].
b.	Less than or equal to 50xPEL	(1)	Full facepiece[2] respirator with HEPA1 cartridge or canister.
c.	Less than or equal to 1000xPEL	(1)	Full facepiece powered air-purifying respirator with HEPA[1] cartridges[2]
d.	Greater than 1000xPEL or unknown	(1) (2)	Self-contained breathing concentrations apparatus with full facepiece in positive pressure mode; Full facepiece positive pressure demand supplied-air respirator with auxiliary self-contained air supply.
e.	Escape	(1) (2)	Any full facepiece air-purifying respirator with HEPA[1] cartridges[2]; Any positive pressure or continuous flow self-contained breathing apparatus with full facepiece or hood.
f.	Fire fighting	(1)	Full facepiece self-contained breathing apparatus in positive pressure demand mode.

Note: Respirators assigned for higher environmental concentrations may be used at lower concentrations.

[1] High efficiency particulate in air filter (HEPA) means a filter that is at least 99.97 percent efficient against mono-dispersed particles of 0.3 micrometers or larger.

[2] Combination HEPA/organic vapor cartridges shall be used whenever MDA in liquid form or a process requiring heat is used.

(b) Any employee who cannot use a negative-pressure respirator must be given the option of using a positive-pressure respirator, or a supplied-air respirator operated in the continuous-flow or pressure-demand mode.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07615, filed 05/04/99, effective 09/01/99.]
Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07615, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07617 Protective work clothing and equipment.

(1) **Provision and use.** Where employees are subject to dermal exposure to MDA, where liquids containing MDA can be splashed into the eyes, or where airborne concentrations of MDA are in excess of the PEL, the employer shall provide, at no cost to the employee, and ensure that the employee uses, appropriate protective work clothing and equipment which prevent contact with MDA such as, but not limited to:

(a) Aprons, coveralls, or other full-body work clothing;

(b) Gloves, head coverings, and foot coverings; and

(c) Face shields, chemical goggles; or

(d) Other appropriate protective equipment which comply with WAC 296-800-160.

(2) **Removal and storage.**

(a) The employer shall ensure that, at the end of their work shift, employees remove MDA-contaminated protective work clothing and equipment that is not routinely removed throughout

the day in change rooms provided in accordance with the provisions established for change rooms.

WAC 296-62-07617 (Cont.)

(b) The employer shall ensure that, during their work shift, employees remove all other MDA-contaminated protective work clothing or equipment before leaving a regulated area.

(c) The employer shall ensure that no employee takes MDA-contaminated work clothing or equipment out of the change room, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

(d) MDA-contaminated work clothing or equipment shall be placed and stored in closed containers which prevent dispersion of the MDA outside the container.

(e) Containers of MDA-contaminated protective work clothing or equipment which are to be taken out of change rooms or the workplace for cleaning, maintenance, or disposal shall bear labels warning of the hazards of MDA.

(3) **Cleaning and replacement.**

(a) The employer shall provide the employee with clean protective clothing and equipment. The employer shall ensure that protective work clothing or equipment required by this paragraph is cleaned, laundered, repaired, or replaced at intervals appropriate to maintain its effectiveness.

(b) The employer shall prohibit the removal of MDA from protective work clothing or equipment by blowing, shaking, or any methods which allow MDA to reenter the workplace.

(c) The employer shall ensure that laundering of MDA-contaminated clothing shall be done so as to prevent the release of MDA in the workplace.

(d) Any employer who gives MDA-contaminated clothing to another person for laundering shall inform such person of the requirement to prevent the release of MDA.

(e) The employer shall inform any person who launders or cleans protective clothing or equipment contaminated with MDA of the potentially harmful effects of exposure.

(f) MDA-contaminated clothing shall be transported in properly labeled, sealed, impermeable bags or containers.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07617, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 94-20-057 (Order 94-16), 296-62-07617, filed 9/30/94, effective 11/20/94; 93-04-111 (Order 92-15), 296-62-07617, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07619 Hygiene facilities and practices.

(1) **Change rooms.**

(a) The employer shall provide clean change rooms for employees, who must wear protective clothing, or who must use protective equipment because of their exposure to MDA.

(b) Change rooms must be equipped with separate storage for protective clothing and equipment and for street clothes which prevents MDA contamination of street clothes.

(2) **Showers.**

(a) The employer shall ensure that employees, who work in areas where there is the potential for exposure resulting from airborne MDA (e.g., particulates or vapors) above the action level, shower at the end of the work shift.

WAC 296-62-07619 (Cont.)

(i) Shower facilities required by this section shall comply with WAC 296-24-12010.

(ii) The employer shall ensure that employees who are required to shower pursuant to the provisions contained herein do not leave the workplace wearing any protective clothing or equipment worn during the work shift.

(b) Where dermal exposure to MDA occurs, the employer shall ensure that materials spilled or deposited on the skin are removed as soon as possible by methods which do not facilitate the dermal absorption of MDA.

(3) **Lunch facilities.**

(a) Availability and construction.

(i) Whenever food or beverages are consumed at the worksite and employees are exposed to MDA at or above the PEL or are subject to dermal exposure to MDA the employer shall provide readily accessible lunch areas.

(ii) Lunch areas located within the workplace and in areas where there is the potential for airborne exposure to MDA at or above the PEL shall have a positive pressure, temperature controlled, filtered air supply.

(iii) Lunch areas may not be located in areas within the workplace where the potential for dermal exposure to MDA exists.

(b) The employer shall ensure that employees who have been subjected to dermal exposure to MDA or who have been exposed to MDA above the PEL wash their hands and faces with soap and water prior to eating, drinking, smoking, or applying cosmetics.

(c) The employer shall ensure that employees exposed to MDA do not enter lunch facilities with MDA-contaminated protective work clothing or equipment.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07619, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07621 Communication of hazards to employees.

(1) **Signs and labels.**

(a) The employer shall post and maintain legible signs demarcating regulated areas and entrances or accessways to regulated areas that bear the following legend:

**DANGER MDA MAY CAUSE CANCER LIVER TOXIN
AUTHORIZED PERSONNEL ONLY RESPIRATORS AND PROTECTIVE CLOTHING
MAY BE REQUIRED TO BE WORN IN THIS AREA**

(b) The employer shall ensure that labels or other appropriate forms of warning are provided for containers of MDA within the workplace. The labels shall comply with the requirements of WAC 296-800-170 and shall include the following legend:

(i) For pure MDA

DANGER CONTAINS MDA MAY CAUSE CANCER LIVER TOXIN

(ii) For mixtures containing MDA

WAC 296-62-07621 (Cont.)

**DANGER CONTAINS MDA CONTAINS MATERIALS
WHICH MAY CAUSE CANCER LIVER TOXIN**

(2) **Material safety data sheets (MSDS).**

(a) Employers shall obtain or develop, and shall provide access to their employees, to a material safety data sheet (MSDS) for MDA. In meeting this obligation, employers shall make appropriate use of the information found in Appendices A and B.

(b) Employers who are manufacturers or importers shall:

(i) Comply with subdivision (1)(b) of this section as appropriate; and

(ii) Comply with the requirement in WISHA hazard communication standard, WAC 296-62-054, that they deliver to downstream employers an MSDS for MDA.

(3) **Information and training.**

(a) The employer shall provide employees with information and training on MDA, in accordance with WAC 296-800-170, at the time of initial assignment and at least annually thereafter.

(b) In addition to the information required under WAC 296-800-170, the employer shall:

(i) Provide an explanation of the contents of WAC 296-62-076, including Appendices A and B, and indicate to employees where a copy of the standard is available;

(ii) Describe the medical surveillance program required under WAC 296-62-07625, and explain the information contained in Appendix C; and

(iii) Describe the medical removal provision required under WAC 296-62-07625.

(4) **Access to training materials.**

(a) The employer shall make readily available to all affected employees, without cost, all written materials relating to the employee training program, including a copy of this regulation.

(b) The employer shall provide to the director, upon request, all information and training materials relating to the employee information and training program.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07621, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07621, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07623 Housekeeping.

(1) All surfaces shall be maintained as free as practicable of visible accumulations of MDA.

(2) The employer shall institute a program for detecting MDA leaks, spills, and discharges, including regular visual inspections of operations involving liquid or solid MDA.

(3) All leaks shall be repaired and liquid or dust spills cleaned up promptly.

(4) Surfaces contaminated with MDA may not be cleared by the use of compressed air.

WAC 296-62-07623 (Cont.)

(5) Shoveling, dry sweeping, and other methods of dry clean-up of MDA may be used where HEPA-filtered vacuuming and/or wet cleaning are not feasible or practical.

(6) Waste, scrap, debris, bags, containers, equipment, and clothing contaminated with MDA shall be collected and disposed of in a manner to prevent the reentry of MDA into the workplace.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07623, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07625 Medical surveillance.

(1) **General.**

(a) The employer shall make available a medical surveillance program for employees exposed to MDA:

(i) Employees exposed at or above the action level for 30 or more days per year;

(ii) Employees who are subject to dermal exposure to MDA for 15 or more days per year;

(iii) Employees who have been exposed in an emergency situation;

(iv) Employees whom the employer, based on results from compliance with WAC 296-62-07609(8), has reason to believe are being dermally exposed; and

(v) Employees who show signs or symptoms of MDA exposure.

(b) The employer shall ensure that all medical examinations and procedures are performed by, or under the supervision of, a licensed physician, at a reasonable time and place, and provided without cost to the employee.

(2) **Initial examinations.**

(a) Within 150 days of the effective date of this standard, or before the time of initial assignment, the employer shall provide each employee covered by subdivision (1)(a) of this section with a medical examination including the following elements:

(i) A detailed history which includes:

(A) Past work exposure to MDA or any other toxic substances;

(B) A history of drugs, alcohol, tobacco, and medication routinely taken (duration and quantity); and

(C) A history of dermatitis, chemical skin sensitization, or previous hepatic disease.

(ii) A physical examination which includes all routine physical examination parameters, skin examination, and signs of liver disease.

(iii) Laboratory tests including:

(A) Liver function tests; and

(B) Urinalysis.

WAC 296-62-07625 (Cont.)

(iv) Additional tests as necessary in the opinion of the physician.

(b) No initial medical examination is required if adequate records show that the employee has been examined in accordance with the requirements of WAC 296-62-076 within the previous six months prior to the effective date of this standard or prior to the date of initial assignment.

(3) **Periodic examinations.**

(a) The employer shall provide each employee covered by WAC 296-62-076 with a medical examination at least annually following the initial examination. These periodic examinations shall include at least the following elements:

(i) A brief history regarding any new exposure to potential liver toxins, changes in drug, tobacco, and alcohol intake, and the appearance of physical signs relating to the liver and the skin;

(ii) The appropriate tests and examinations including liver function tests and skin examinations; and

(iii) Appropriate additional tests or examinations as deemed necessary by the physician.

(b) If in the physicians' opinion the results of liver function tests indicate an abnormality, the employee shall be removed from further MDA exposure in accordance with WAC 296-62-07627 and 296-62-07629. Repeat liver function tests shall be conducted on advice of the physician.

(4) **Emergency examinations.** If the employer determines that the employee has been exposed to a potentially hazardous amount of MDA in an emergency situation as addressed in WAC 296-62-07607, the employer shall provide medical examinations in accordance with subsection (3) of this section. If the results of liver function testing indicate an abnormality, the employee shall be removed in accordance with WAC 296-62-07627 and 296-62-07629. Repeat liver function tests shall be conducted on the advice of the physician. If the results of the tests are normal, tests must be repeated two to three weeks from the initial testing. If the results of the second set of tests are normal and on the advice of the physician, no additional testing is required.

(5) **Additional examinations.** Where the employee develops signs and symptoms associated with exposure to MDA, the employer shall provide the employee with an additional medical examination including a liver function test. Repeat liver function tests shall be conducted on the advice of the physician. If the results of the tests are normal, tests must be repeated two to three weeks from the initial testing. If the results of the second set of tests are normal and, on the advice of the physician, no additional testing is required.

(6) **Multiple physician review mechanism.**

(a) If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under WAC 296-62-076, and the employee has signs or symptoms of occupational exposure to MDA (which could include an abnormal liver function test), and the employee disagrees with the opinion of the examining physician, and this opinion could affect the employee's job status, the employee may designate an appropriate, mutually acceptable second physician:

(i) To review any findings, determinations, or recommendations of the initial physician; and

(ii) To conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

WAC 296-62-07625 (Cont.)

(b) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician conducts a medical examination or consultation pursuant to WAC 296-62-076. The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen days after receipt of the foregoing notification, or receipt of the initial physician's written opinion, whichever is later:

(i) The employee informing the employer that he or she intends to seek a second medical opinion; and

(ii) The employee initiating steps to make an appointment with a second physician.

(c) If the findings, determinations, or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve any disagreement.

(d) If the two physicians have been unable to resolve quickly their disagreement, then the employer and the employee through their respective physicians shall designate a third physician:

(i) To review any findings, determinations, or recommendations of the prior physicians; and

(ii) To conduct such examinations, consultations, laboratory tests, and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(e) The employer shall act consistent with the findings, determinations, and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(7) **Information provided to the examining and consulting physicians.**

(a) The employer shall provide the following information to the examining physician:

(i) A copy of this regulation and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's potential exposure to MDA;

(iii) The employee's current actual or representative MDA exposure level;

(iv) A description of any personal protective equipment used or to be used; and

(v) Information from previous employment-related medical examinations of the affected employee.

(b) The employer shall provide the foregoing information to a second physician under this section upon request either by the second physician or by the employee.

(8) **Physician's written opinion.**

(a) For each examination under WAC 296-62-076, the employer shall obtain, and provide the employee with a copy of, the examining physician's written opinion within 15 days of its receipt. The written opinion shall include the following:

WAC 296-62-07625 (Cont.)

(i) The occupationally-pertinent results of the medical examination and tests;

(ii) The physician's opinion concerning whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of health from exposure to MDA;

(iii) The physician's recommended limitations upon the employee's exposure to MDA or upon the employee's use of protective clothing or equipment and respirators; and

(iv) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions resulting from MDA exposure which require further explanation or treatment.

(b) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07625, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07627 Medical removal--Temporary medical removal of an employee. Temporary medical removal of an employee.

(1) **Temporary removal resulting from occupational exposure.** The employee shall be removed from work environments in which exposure to MDA is at or above the action level or where dermal exposure to MDA may occur, following an initial examination (WAC 296-62-07625(2)), periodic examinations (WAC 296-62-07625(3)), an emergency situation (WAC 296-62-07625(4)), or an additional examination (WAC 296-62-07625(5)) in the following circumstances:

(a) When the employee exhibits signs and/or symptoms indicative of acute exposure to MDA; or

(b) When the examining physician determines that an employee's abnormal liver function tests are not associated with MDA exposure but that the abnormalities may be exacerbated as a result of occupational exposure to MDA.

(c) Temporary removal due to a final medical determination.

(i) The employer shall remove an employee from work environments in which exposure to MDA is at or above the action level or where dermal exposure to MDA may occur, on each occasion that there is a final medical determination or opinion that the employee has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to MDA.

(ii) For the purposes of WAC 296-62-076, the phrase “final medical determination” shall mean the outcome of the physician review mechanism used pursuant to the medical surveillance provisions of this section.

(iii) Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to MDA, the employer shall implement and act consistent with the recommendation.

(2) **Return of the employee to former job status.**

(a) The employer shall return an employee to his or her former job status:

(i) When the employee no longer shows signs or symptoms of exposure to MDA or upon the advice of the physician.

WAC 296-62-07627 (Cont.)

(ii) When a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to MDA.

(b) For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(3) **Removal of other employee special protective measure or limitations.** The employer shall remove any limitations placed on an employee, or end any special protective measures provided to an employee, pursuant to a final medical determination, when a subsequent final medical determination indicates that the limitations or special protective measures are no longer necessary.

(4) **Employer options pending a final medical determination.** Where the physician review mechanism used pursuant to the medical surveillance provisions of WAC 296-62-076, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

(a) Removal. The employer may remove the employee from exposure to MDA, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

(b) Return. The employer may return the employee to his or her former job status, and end any special protective measures provided to the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status, with two exceptions.

(i) If the initial removal, special protection, or limitation of the employee resulted from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician; or

(ii) If the employee has been on removal status for the preceding six months as a result of exposure to MDA, then the employer shall await a final medical determination.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07627, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07629 Medical removal protection benefits.

(1) **Provisions of medical removal protection benefits.** The employer shall provide to an employee up to six months of medical removal protection benefits on each occasion that an employee is removed from exposure to MDA or otherwise limited pursuant to this section.

(2) **Definition of medical removal protection benefits.** For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that the employer shall maintain the earnings, seniority, and other employment rights and benefits of an employee as though the employee had not been removed from normal exposure to MDA or otherwise limited.

(3) **Follow-up medical surveillance during the period of employee removal or limitations.** During the period of time that an employee is removed from normal exposure to MDA or otherwise limited, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to WAC 296-62-076.

WAC 296-62-07629 (Cont.)

(4) **Workers' compensation claims.** If a removed employee files a claim for workers' compensation payments for an MDA-related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for workers' compensation payments received by the employee for treatment-related expenses.

(5) **Other credits.** The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer-funded compensation program, or receives income from non-MDA-related employment with any employer made possible by virtue of the employee's removal.

(6) **Employees who do not recover within the 6 months of removal.** The employer shall take the following measures with respect to any employee removed from exposure to MDA:

(a) The employer shall make available to the employee a medical examination pursuant to this section to obtain a final medical determination with respect to the employee;

(b) The employer shall assure that the final medical determination obtained indicates whether or not the employee may be returned to his or her former job status, and, if not, what steps should be taken to protect the employee's health;

(c) Where the final medical determination has not yet been obtained, or, once obtained indicates that the employee may not yet be returned to his or her former job status, the employer shall continue to provide medical removal protection benefits to the employee until either the employee is returned to former job status, or a final medical determination is made that the employee is incapable of ever safely returning to his or her former job status; and

(d) Where the employer acts pursuant to a final medical determination which permits the return of the employee to his or her former job status, despite what would otherwise be an abnormal liver function test, later questions concerning removing the employee again shall be decided by a final medical determination. The employer need not automatically remove such an employee pursuant to the MDA removal criteria provided by WAC 296-62-076.

(7) **Voluntary removal or restriction of an employee.** Where an employer, although not required by WAC 296-62-076 to do so, removes an employee from exposure to MDA or otherwise places limitations on an employee due to the effects of MDA exposure on the employee's medical condition, the employer shall provide medical removal protection benefits to the employee equal to that required by this section.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07629, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07631 Recordkeeping.

(1) **Monitoring data for exempted employers.**

(a) Where as a result of the initial monitoring the processing, use, or handling of products made from or containing MDA are exempted from other requirements of this section under WAC 296-62-07601(2), the employer shall establish and maintain an accurate record of monitoring relied on in support of the exemption.

(b) This record shall include at least the following information:

(i) The product qualifying for exemption;

WAC 296-62-07631 (Cont.)

(ii) The source of the monitoring data (e.g., was monitoring performed by the employer or a private contractor);

(iii) The testing protocol, results of testing, and/or analysis of the material for the release of MDA;

(iv) A description of the operation exempted and how the data support the exemption (e.g., are the monitoring data representative of the conditions at the affected facility); and

(v) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(c) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(2) **Objective data for exempted employers.**

(a) Where the processing, use, or handling of products made from or containing MDA are exempted from other requirements of WAC 296-62-076 under WAC 296-62-07601, the employer shall establish and maintain an accurate record of objective data relied upon in support of the exemption.

(b) This record shall include at least the following information:

(i) The product qualifying for exemption;

(ii) The source of the objective data;

(iii) The testing protocol, results of testing, and/or analysis of the material for the release of MDA;

(iv) A description of the operation exempted and how the data support the exemption; and

(v) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(c) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

(3) **Exposure measurements.**

(a) The employer shall establish and maintain an accurate record of all measurements required by WAC 296-62-07609, in accordance with Part B of this chapter.

(b) This record shall include:

(i) The dates, number, duration, and results of each of the samples taken, including a description of the procedure used to determine representative employee exposures;

(ii) Identification of the sampling and analytical methods used;

(iii) A description of the type of respiratory protective devices worn, if any; and

WAC 296-62-07631 (Cont.)

(iv) The name, Social Security number, job classification, and exposure levels of the employee monitored and all other employees whose exposure the measurement is intended to represent.

(c) The employer shall maintain this record for at least 30 years, in accordance with Part B of this chapter.

(4) **Medical surveillance.**

(a) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance required by WAC 296-62-07625, 296-62-07627, and 296-62-07629, in accordance with Part B of this chapter.

(b) This record shall include:

(i) The name, Social Security number, and description of the duties of the employee;

(ii) The employer's copy of the physician's written opinion on the initial, periodic, and any special examinations, including results of medical examination and all tests, opinions, and recommendations;

(iii) Results of any airborne exposure monitoring done for that employee and the representative exposure levels supplied to the physician; and

(iv) Any employee medical complaints related to exposure to MDA.

(c) The employer shall keep, or assure that the examining physician keeps, the following medical records:

(i) A copy of this standard and its appendices, except that the employer may keep one copy of the standard and its appendices for all employees provided the employer references the standard and its appendices in the medical surveillance record of each employee;

(ii) A copy of the information provided to the physician as required by any sections in the regulatory text;

(iii) A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to the information;

(iv) A copy of the employee's medical and work history related to exposure to MDA.

(d) The employer shall maintain this record for at least the duration of employment plus 30 years, in accordance with Part B of this chapter.

(5) **Medical removals.**

(a) The employer shall establish and maintain an accurate record for each employee removed from current exposure to MDA pursuant to WAC 296-62-07625, 296-62-07627, and 296-62-07629.

(b) Each record shall include:

(i) The name and Social Security number of the employee;

WAC 296-62-07631 (Cont.)

(ii) The date of each occasion that the employee was removed from current exposure to MDA as well as the corresponding date on which the employee was returned to his or her former job status;

(iii) A brief explanation of how each removal was or is being accomplished; and

(iv) A statement with respect to each removal indicating the reason for the removal.

(c) The employer shall maintain each medical removal record for at least the duration of an employee's employment plus 30 years.

(6) **Availability.**

(a) The employer shall assure that records required to be maintained by WAC 296-62-076 shall be made available, upon request, to the director for examination and copying.

(b) Employee exposure monitoring records required by WAC 296-62-076 shall be provided upon request for examination and copying to employees, employee representatives, and the director in accordance with the applicable sections of WAC 296-800-170.

(c) Employee medical records required by this section shall be provided upon request for examination and copying, to the subject employee, to anyone having the specific written consent of the subject employee, and to the director in accordance with Part B of this chapter.

(7) **Transfer of records.**

(a) The employer shall comply with the requirements involving transfer of records set forth in WAC 296-62-05215.

(b) If the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the director, at least 90 days prior to disposal, and transmit the records to the director if so requested by the director within that period.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07631, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07631, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07633 Observation of monitoring.

(1) **Employee observation.** The employer shall provide affected employees, or their designated representatives, an opportunity to observe the measuring or monitoring of employee exposure to MDA conducted pursuant to WAC 296-62-07609.

(2) **Observation procedures.** When observation of the measuring or monitoring of employee exposure to MDA requires entry into areas where the use of protective clothing and equipment or respirators is required, the employer shall provide the observer with personal protective clothing and equipment or respirators required to be worn by employees working in the area, assure the use of such clothing and equipment or respirators, and require the observer to comply with all other applicable safety and health procedures.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07633, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07637 Appendices. The information contained in Appendices A, B, C, and D of WAC 296-62-076 is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation. The protocols for respiratory fit testing in Appendix E of WAC 296-62-076 are mandatory.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07637, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07654 Appendix A to WAC 296-62-076--Substance data sheet, for 4,4'-methylenedianiline.

(1) **Substance identification.**

(a) Substance: Methylenedianiline (MDA).

(b) Permissible exposure:

(i) Airborne: Ten parts per billion parts of air (10 ppb), time-weighted average (TWA) for an 8-hour workday and an action level of five parts per billion parts of air (5 ppb).

(ii) Dermal: Eye contact and skin contact with MDA are not permitted.

(c) Appearance and odor: White to tan solid; amine odor.

(2) **Health hazard data.**

(a) Ways in which MDA affects your health. MDA can affect your health if you inhale it, or if it comes in contact with your skin or eyes. MDA is also harmful if you happen to swallow it. Do not get MDA in eyes, on skin, or on clothing.

(b) Effects of overexposure.

(i) Short-term (acute) overexposure: Overexposure to MDA may produce fever, chills, loss of appetite, vomiting, jaundice. Contact may irritate skin, eyes, and mucous membranes. Sensitization may occur.

(ii) Long-term (chronic) exposure. Repeated or prolonged exposure to MDA, even at relatively low concentrations, may cause cancer. In addition, damage to the liver, kidneys, blood, and spleen may occur with long-term exposure.

(iii) Reporting signs and symptoms: You should inform your employer if you develop any signs or symptoms which you suspect are caused by exposure to MDA including yellow staining of the skin.

(3) **Protective clothing and equipment.**

(a) Respirators. Respirators are required for those operations in which engineering controls or work practice controls are not adequate or feasible to reduce exposure to the permissible limit. If respirators are worn, they must have the joint Mine Safety and Health Administration and National Institute for Occupational Safety and Health (NIOSH) seal of approval, and cartridges or canisters must be replaced as necessary to maintain the effectiveness of the respirator. If you experience difficulty breathing while wearing a respirator, you may request a positive pressure respirator from your employer. You must be thoroughly trained to use the assigned respirator, and the training will be provided by your employer. MDA does not have a detectable odor except at levels well above the permissible exposure limits. Do not depend on odor to warn you when a respirator canister is exhausted. If you can smell MDA while wearing a respirator, proceed immediately to fresh air. If you experience difficulty breathing while wearing a respirator, tell your employer.

(b) Protective clothing. You may be required to wear coveralls, aprons, gloves, face shields, or other appropriate protective clothing to prevent skin contact with MDA. Where protective clothing is required, your employer is required to provide clean garments to you, as necessary, to assure that the clothing protects you adequately. Replace or repair impervious clothing that has developed leaks. MDA should never be allowed to remain on the skin. Clothing and shoes which are not

WAC 296-62-07654 (Cont.)

impervious to MDA should not be allowed to become contaminated with MDA, and if they do, the clothing and shoes should be promptly removed and decontaminated. The clothing should be laundered to remove MDA or discarded. Once MDA penetrates shoes or other leather articles, they should not be worn again.

(c) Eye protection. You must wear splashproof safety goggles in areas where liquid MDA may contact your eyes. Contact lenses should not be worn in areas where eye contact with MDA can occur. In addition, you must wear a face shield if your face could be splashed with MDA liquid.

(4) **Emergency and first aid procedures.**

(a) Eye and face exposure. If MDA is splashed into the eyes, wash the eyes for at least 15 minutes. See a doctor as soon as possible.

(b) Skin exposure. If MDA is spilled on your clothing or skin, remove the contaminated clothing and wash the exposed skin with large amounts of soap and water immediately. Wash contaminated clothing before you wear it again.

(c) Breathing. If you or any other person breathes in large amounts of MDA, get the exposed person to fresh air at once. Apply artificial respiration if breathing has stopped. Call for medical assistance or a doctor as soon as possible. Never enter any vessel or confined space where the MDA concentration might be high without proper safety equipment and at least one other person present who will stay outside. A life line should be used.

(d) Swallowing. If MDA has been swallowed and the patient is conscious, do not induce vomiting. Call for medical assistance or a doctor immediately.

(5) **Medical requirements.** If you are exposed to MDA at a concentration at or above the action level for more than 30 days per year, or exposed to liquid mixtures more than 15 days per year, your employer is required to provide a medical examination, including a medical history and laboratory tests, within 60 days of the effective date of this standard and annually thereafter. These tests shall be provided without cost to you. In addition, if you are accidentally exposed to MDA (either by ingestion, inhalation, or skin/eye contact) under conditions known or suspected to constitute toxic exposure to MDA, your employer is required to make special examinations and tests available to you.

(6) **Observation of monitoring.** Your employer is required to perform measurements that are representative of your exposure to MDA and you or your designated representative are entitled to observe the monitoring procedure. You are entitled to observe the steps taken in the measurement procedure and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you and your representative must also be provided with, and must wear, the protective clothing and equipment.

(7) **Access to records.** You or your representative are entitled to see the records of measurements of your exposure to MDA upon written request to your employer. Your medical examination records can be furnished to your physician or designated representative upon request by you to your employer.

(8) **Precautions for safe use, handling, and storage.**

(a) Material is combustible. Avoid strong acids and their anhydrides. Avoid strong oxidants. Consult supervisor for disposal requirements.

(b) Emergency clean-up. Wear self-contained breathing apparatus and fully clothe the body in the appropriate personal protective clothing and equipment.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07654, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07656 Appendix B to WAC 296-62-076--Substance technical guidelines, MDA.

(1) **Identification.**

(a) Substance identification. Synonyms: CAS No. 101-77-9. 4,4'-methylenedianiline; 4,4'-methylenebisaniline; methylenedianiline; dianilinomethane.

(b) Formula: $C_{13}H_{14}N_2$.

(2) **Physical data.**

(a) Appearance and odor: White to tan solid; amine odor.

(b) Molecular weight: 198.26.

(c) Boiling point: 398-399 degrees C. at 760 mm Hg.

(d) Melting point: 88-93 degrees C. (190-100 degrees F.).

(e) Vapor pressure: 9 mmHg at 232 degrees C.

(f) Evaporation rate (n-butyl acetate = 1): Negligible.

(g) Vapor density (Air = 1): Not applicable.

(h) Volatile fraction by weight: Negligible.

(i) Specific gravity (Water = 1): Slight.

(j) Heat of combustion: -8.40 kcal/g.

(k) Solubility in water: Slightly soluble in cold water, very soluble in alcohol, benzene, ether, and many organic solvents.

(3) **Fire, explosion, and reactivity hazard data.**

(a) Flash point: 190 degrees C. (374 degrees F.) Setaflash closed cup.

(b) Flash point: 226 degrees C. (439 degrees F.) Cleveland open cup.

(c) Extinguishing media: Water spray; dry chemical; carbon dioxide.

(d) Special fire fighting procedures: Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes.

(e) Unusual fire and explosion hazards: Fire or excessive heat may cause production of hazardous decomposition products.

(d) Hazardous polymerization: Will not occur.

(4) **Reactivity data.**

(a) Stability: Stable

WAC 296-62-07656 (Cont.)

(b) Incompatibility: Strong oxidizers.

(c) Hazardous decomposition products: At with any other organic material, combustion may produce carbon monoxide. Oxides of nitrogen may also be present.

(5) **Spill and leak procedures.**

(a) Sweep material onto paper and place in fiber carton.

(b) Package appropriately for safe feed to an incinerator or dissolve in compatible waste solvents prior to incineration.

(c) Dispose of in an approved incinerator equipped with afterburner and scrubber or contract with licensed chemical waste disposal service.

(d) Discharge treatment or disposal may be subject to federal, state, or local laws.

(e) Wear appropriate personal protective equipment.

(6) **Special storage and handling precautions.**

(a) High exposure to MDA can occur when transferring the substance from one container to another. Such operations should be well ventilated and good work practices must be established to avoid spills.

(b) Pure MDA is a solid with a low vapor pressure. Grinding or heating operations increase the potential for exposure.

(c) Store away from oxidizing materials.

(d) Employers shall advise employees of all areas and operations where exposure to MDA could occur.

(7) **Housekeeping and hygiene facilities.**

(a) The workplace should be kept clean, orderly, and in a sanitary condition. The employer should institute a leak and spill detection program for operations involving MDA in order to detect sources of fugitive MDA emissions.

(b) Adequate washing facilities with hot and cold water are to be provided and maintained in a sanitary condition. Suitable cleansing agents should also be provided to assure the effective removal of MDA from the skin.

(8) **Common operations.** Common operations in which exposure to MDA is likely to occur include the following: Manufacture of MDA; manufacture of methylene diisocyanate; curing agent for epoxy resin structures; wire coating operations; and filament winding.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07656, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07658 Appendix C to WAC 296-62-076--Medical surveillance guidelines for MDA.

(1) **Route of entry:**

Inhalation; skin absorption; ingestion. MDA can be inhaled, absorbed through the skin, or ingested.

WAC 296-62-07658 (Cont.)

(2) **Toxicology:**

MDA is a suspect carcinogen in humans. There are several reports of liver disease in humans and animals resulting from acute exposure to MDA. A well documented case of an acute cardiomyopathy secondary to exposure to MDA is on record. Numerous human cases of hepatitis secondary to MDA are known. Upon direct contact MDA may also cause damage to the eyes. Dermatitis and skin sensitization have been observed. Almost all forms of acute environmental hepatic injury in humans involve the hepatic parenchyma and produce hepatocellular jaundice. This agent produces intrahepatic cholestasis. The clinical picture consists of cholestatic jaundice, preceded or accompanied by abdominal pain, fever, and chills. Onset in about 60 percent of all observed cases is abrupt with severe abdominal pain. In about 30 percent of observed cases, the illness presented and evolved more slowly and less dramatically, with only slight abdominal pain. In about 10 percent of the cases only jaundice was evident. The cholestatic nature of the jaundice is evident in the prominence of itching, the histologic predominance of bile stasis, and portal inflammatory infiltration, accompanied by only slight parenchymal injury in most cases, and by the moderately elevated transaminase values. Acute, high doses, however, have been known to cause hepatocellular damage resulting in elevated SGPT, SGOT, alkaline phosphatase, and bilirubin.

Absorption through the skin is rapid. MDA is metabolized and excreted over a 48-hour period. Direct contact may be irritating to the skin, causing dermatitis. Also MDA which is deposited on the skin is not thoroughly removed through washing.

MDA may cause bladder cancer in humans. Animal data supporting this assumption is not available nor is conclusive human data. However, human data collected on workers at a helicopter manufacturing facility where MDA is used suggests a higher incidence of bladder cancer among exposed workers.

(3) **Signs and symptoms:**

Skin may become yellow from contact with MDA.

Repeated or prolonged contact with MDA may result in recurring dermatitis (red-itchy, cracked skin) and eye irritation. Inhalation, ingestion, or absorption through the skin at high concentrations may result in hepatitis, causing symptoms such as fever and chills, nausea and vomiting, dark urine, anorexia, rash, right upper quadrant pain, and jaundice. Corneal burns may occur when MDA is splashed in the eyes.

(4) **Treatment of acute toxic effects/emergency situation:**

If MDA gets into the eyes, immediately wash eyes with large amounts of water. If MDA is splashed on the skin, immediately wash contaminated skin with mild soap or detergent. Employee should be removed from exposure and given proper medical treatment. Medical tests required under the emergency section of the medical surveillance subsection (13)(d) must be conducted. If the chemical is swallowed do not induce vomiting but remove by gastric lavage.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07658, filed 2/3/93, effective 3/15/93.]

WAC 296-62-07660 Appendix D to WAC 296-62-076--Sampling and analytical methods for MDA monitoring and measurement procedures. Measurements taken for the purpose of determining employee exposure to MDA are best taken so that the representative average 8-hour exposure may be determined from a single 8-hour sample or two 4-hour samples. Short-time interval samples (or grab samples) may also be used to determine average exposure level if a minimum of five measurements are taken in a random manner over the 8-hour work shift. Random sampling means that any portion of the work shift has the same chance of being sampled as any other. The arithmetic average of all such random samples taken on one work shift is an estimate of an employee's average level of exposure for that work shift. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

There are a number of methods available for monitoring employee exposures to MDA. The method WISHA currently uses is included below.

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The employer, however, has the obligation of selecting any monitoring method which meets the accuracy and precision requirements of the standard under his/her unique field conditions. The standard requires that the method of monitoring must have an accuracy, to a 95 percent confidence level, of not less than plus or minus 25 percent for the select PEL.

WISHA methodology.

Sampling procedure.

Apparatus:

Samples are collected by use of a personal sampling pump that can be calibrated within +5 percent of the recommended flow rate with the sampling filter in line.

Samples are collected on 37 mm Gelman type A/E glass fiber filters treated with sulfuric acid. The filters are prepared by soaking each filter with 0.5 mL of 0.26N H_2SO_4. (0.26 N H_2SO_4 can be prepared by diluting 1.5 mL of 36N H_2SO_4 to 200 mL with deionized water.) The filters are dried in an oven at 100 degrees C. for one hour and then assembled into three-piece 37 mm polystyrene cassettes without backup pads. The front filter is separated from the back filter by a polystyrene spacer. The cassettes are sealed with shrink bands and the ends are plugged with plastic plugs.

After sampling, the filters are carefully removed from the cassettes and individually transferred to small vials containing approximately 2 mL deionized water. The vials must be tightly sealed. The water can be added before or after the filters are transferred. The vials must be sealable and capable of holding at least 7 mL of liquid. Small glass scintillation vials with caps containing Teflon liners are recommended.

Reagents:

Deionized water is needed for addition to the vials.

Sampling technique:

Immediately before sampling, remove the plastic plugs from the filter cassettes.

Attach the cassette to the sampling pump with flexible tubing and place the cassette in the employee's breathing zone.

After sampling, seal the cassettes with plastic plugs until the filters are transferred to the vials containing deionized water.

At some convenient time within 10 hours of sampling, transfer the sample filters to vials.

Seal the small vials lengthwise.

Submit at least one blank filter with each sample set. Blanks should be handled in the same manner as samples, but no air is drawn through them.

Record sample volumes (in L of air) for each sample, along with any potential interferences.

Retention efficiency:

A retention efficiency study was performed by drawing 100 L of air (80 percent relative humidity) at 1 L/min through sample filters that had been spiked with 0.814 microgram MDA. Instead of using backup

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pads, blank acid-treated filters were used as backups in each cassette. Upon analysis, the top filters were found to have an average of 91.8 percent of the spiked amount. There was no MDA found on the bottom filters, so the amount lost was probably due to the slight instability of the MDA salt.

Extraction efficiency:

The average extraction efficiency for six filters spiked at the target concentration is 99.6 percent.

The stability of extracted and derivatized samples was verified by reanalyzing the above six samples the next day using fresh standards. The average extraction efficiency for the reanalyzed samples is 98.7 percent.

Recommended air volume and sampling rate:

The recommended air volume is 100 L.

The recommended sampling rate is 1 L/min.

Interferences (sampling):

MDI appears to be a positive interference. It was found that when MDI was spiked onto an acid-treated filter, the MDI converted to MDA after air was drawn through it.

Suspected interferences should be reported to the laboratory with submitted samples.

Safety precautions (sampling):

Attach the sampling equipment to the employees so that it will not interfere with work performance or safety.

Follow all safety procedures that apply to the work area being sampled.

Analytical procedure:

Apparatus: The following are required for analysis.

A GC equipped with an electron capture detector. For this evaluation a Hewlett Packard 5880 Gas Chromatograph equipped with a Nickel 63 High Temperature Electron Capture Detector and a Linearizer was used.

A GC column capable of separating the MDA derivative from the solvent and interferences. A 6 ft X 2 mm ID glass column packed with 3 percent OV-101 coated on 100/120 Gas Chrom Q or a 25 meter DB-1 or DB-5 capillary column is recommended for this evaluation.

A electronic integrator or some other suitable means of measuring peak areas or heights.

Small resealable vials with Teflon-lined caps capable of holding 4 mL.

A dispenser or pipet for toluene capable of delivering 2.0 mL.

Pipets (or repipets with plastic or Teflon tips) capable of delivering 1 mL for the sodium hydroxide and buffer solutions.

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A repipet capable of delivering 25 micro-L HFAA.

Syringes for preparation of standards and injection of standards and samples into a GC.

Volumetric flasks and pipets to dilute the pure MDA in preparation of standards.

Disposable pipets to transfer the toluene layers after the samples are extracted.

Reagents:

0.5 NaOH prepared from reagent grade NaOH.

Toluene, pesticide grade. Burdick and Jackson distilled in glass toluene was used.

Heptafluorobutyric acid anhydride (HFAA). HFAA from Pierce Chemical Company was used.

pH 7.0 phosphate buffer, prepared from 136 g potassium dihydrogen phosphate and 1 L deionized water. The pH is adjusted to 7.0 with saturated sodium hydroxide solution.

4,4'-Methylenedianiline (MDA), reagent grade.

Standard preparation:

Concentrated stock standards are prepared by diluting pure MDA with toluene. Analytical standards are prepared by injecting uL amounts of diluted stock standards into vials that contain 2.0 mL toluene.

25 µL HFAA are added to each vial and the vials are capped and shaken for 10 seconds.

After 10 min, 1 mL of buffer is added to each vial.

The vials are recapped and shaken for 10 seconds.

After allowing the layers to separate, aliquots of the toluene (upper) layers are removed with a syringe and analyzed by GC.

Analytical standard concentrations should bracket sample concentrations. Thus, if samples fall out of the range of prepared standards, additional standards must be prepared to ascertain detector response.

Sample preparation:

The sample filters are received in vials containing deionized water.
1 mL of 0.5N NaOH and 2.0 mL toluene are added to each vial.
The vials are recapped and shaken for 10 min.
After allowing the layers to separate, approximately 1 mL aliquots of the toluene (upper) layers are transferred to separate vials with clean disposable pipets.
The toluene layers are treated and analyzed.

Analysis:

GC conditions

Zone temperatures:

Column--220 degrees C.

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Injector--235 degrees C.

Detector--335 degrees C.

C Gas flows, N_2 Column--30 mL/min

He Column 0.9 mL/min. (capillary) with 30 mL/min. A_rCH_4 (95/5) makeup gas

Injection volume: 5.0 uL

Column: 6 ft X 1/8 in ID glass, 3% OV-101 on 100/120 Gas Chrom Q or 25 meter x .25 mm DB-1 or DB-5 capillary

Retention time of MDA derivative: 2.5 to 3.5, depending on column and flow

Chromatogram:

Peak areas or heights are measured by an integrator or other suitable means.

A calibration curve is constructed by plotting response (peak areas or heights) of standard injections versus µg of MDA per sample. Sample concentrations must be bracketed by standards.

Interferences (analytical):

Any compound that gives an electron capture detector response and has the same general retention time as the HFAA derivative of MDA is a potential interference. Suspected interferences reported to the laboratory with submitted samples by the industrial hygienist must be considered before samples are derivatized.

GC parameters may be changed to possibly circumvent interferences.

Retention time on a single column is not considered proof of chemical identity. Analyte identity should be confirmed by GC/MS if possible.

Calculations:

The analyte concentration for samples is obtained from the calibration curve in terms of µg MDA per sample. The extraction efficiency is 100 percent. If any MDA is found on the blank, that amount is subtracted from the sample amounts. The air concentrations are calculated using the following formulae: Microgram/m^3 = (microgram MDA per sample) (1000)/(L of air sampled) ppb = (microgram/m^3) (24.46)/(198.3) = (microgram/m^3)(0.1233) where 24.46 is the molar volume at 25 degrees C. and 760 mm Hg.

Safety precautions (analytical):

Avoid skin contact and inhalation of all chemicals.

Restrict the use of all chemicals to a fume hood if possible.

Wear safety glasses and a lab coat at all times while in the lab area.

[Statutory Authority: Chapter 49.17 RCW. 93-04-111 (Order 92-15), 296-62-07660, filed 2/3/93, effective 3/15/93.]

PART I-1
ASBESTOS, TREMOLITE, ANTHOPHYLLITE, AND ACTINOLITE

WAC

WAC 296-62-077 Asbestos, tremolite, anthophyllite, and actinolite.

[Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-077, filed 4/27/87.]

WAC 296-62-07701 Scope and application.

(1) WAC 296-62-07701 through 296-62-07753 applies to all occupational exposures to asbestos in all industries covered by chapter 49.17 RCW, Washington Industrial Safety and Health Act and chapter 49.26 RCW, Health and Safety--Asbestos.

(2) This part applies to construction work as defined in WAC 296-155-012 except for work involving asbestos-containing asphalt roof coatings, cements, and mastics. The exception for roofing materials does not apply to asphalt coated asbestos felting and similar built-up roofing.

(3) This part applies to ship repairing, shipbuilding and shipbreaking employments and related employments as defined in WAC 296-304-01001 except for work involving asbestos-containing asphalt roof coatings, cements, and mastics. The exception for roofing materials does not apply to asphalt coated asbestos felting and similar built-up roofing.

[Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07701, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07701, filed

12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-07701, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07701, filed 4/27/87.]

WAC 296-62-07703 Definitions. For the purpose of WAC 296-62-07701 through 296-62-07753:

Accredited inspector means any person meeting the accreditation requirements of the Federal Toxic Substance Control Act, Section 206(a)(1) and (3). 15 U.S.C. 2646(a)(1) and (3).

Aggressive method means removal or disturbance of building material by sanding, abrading, grinding or other method that breaks, crumbles, or disintegrates intact ACM.

Amended water means water to which surfactant (wetting agent) has been added to increase the ability of the liquid to penetrate ACM.

Asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, actinolite asbestos, and any of these minerals that have been chemically treated and/or altered.

For purposes of this standard, **"asbestos"** includes PACM, as defined below.

Asbestos abatement project means an asbestos project involving three square feet or three linear feet, or more, of asbestos-containing material.

Asbestos-containing material (ACM) means any material containing more than 1% asbestos.

Asbestos project – includes the construction, demolition, repair, remodeling, maintenance or renovation of any public or private building or structure, mechanical piping equipment or system involving the demolition, removal, encapsulation, salvage, or disposal of material or outdoor activity releasing or likely to release asbestos fibers into the air.

Authorized person means any person authorized by the employer and required by work duties to be present in regulated areas.

Building/facility/vessel owner means any legal entity or person who owns any public or private building, vessel, structure, facility, or mechanical system or the remnants thereof, including the agent of such person, but does not include individuals who work on asbestos projects in their own single-family residences, no part of which is used for commercial purposes. Also included is any lessee, who exercises control over management and recordkeeping functions relating to a building, vessel, and/or facility in which activities covered by this standard takes place.

Certified asbestos supervisor means an individual certified by the department under WAC 296-65-012.

Certified asbestos worker means an individual certified by the department under WAC 296-65-010.

Certified industrial hygienist (CIH) means one certified in the practice of industrial hygiene by the American Board of Industrial Hygiene.

Class I asbestos work means activities involving the removal of thermal system insulation or surfacing ACM/PACM.

Class II asbestos work means activities involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.

Class III asbestos work means repair and maintenance operations where "ACM," including TSI and surfacing ACM and PACM, may be disturbed.

Class IV asbestos work means maintenance and custodial activities during which employees contact but do not disturb ACM or PACM and activities to clean up dust, waste and debris resulting from Class I, II, and III activities.

Clean room means an uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.

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Closely resemble means that the major workplace conditions which have contributed to the levels of historic asbestos exposure, are no more protective than conditions of the current workplace.

Competent person means, in addition to the definition in WAC 296-62-07728, one who is capable of identifying existing asbestos, hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them as specified in WAC 296-62-07728. The competent person shall be certified as an asbestos supervisor in compliance with WAC 296-65-030(3) and 296-65-012 for Class I and Class II work, and for Class III and Class IV work involving 3 square feet or 3 linear feet or more of asbestos-containing material. For Class III and Class IV work, involving less than 3 square feet or 3 linear feet, the competent person shall be trained in an operations and maintenance (O&M) course which meets the criteria of EPA (40 CFR 763.92(a)(2)).

Critical barrier means one or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area.

Decontamination area means an enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment contaminated with asbestos.

Demolition means the wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products. Where feasible, asbestos-containing materials shall be removed from all structures prior to the commencement of any demolition activity as per WAC 296-155-775(9).

Department means the department of labor and industries.

Director means the director of the department of labor and industries or his/her authorized representative.

Director of NIOSH means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

Disturb or disturbance refers to activities that disrupt the matrix of ACM or PACM, crumble or pulverize ACM or PACM, or generate visible debris from ACM or PACM. This term includes activities that disrupt the matrix of ACM or PACM, render ACM or PACM friable, or generate visible debris. Disturbance includes cutting away small amounts of ACM or PACM, no greater than the amount that can be contained in one standard size glove bag or waste bag in order to access a building or vessel component. In no event shall the amount of ACM or PACM so disturbed exceed that which can be contained in one glove bag or waste bag which shall not exceed 60 inches in length and width.

Employee exposure means that exposure to airborne asbestos that would occur if the employee were not using respiratory protective equipment.

Equipment room (change room) means a contaminated room located within the decontamination area that is supplied with impermeable bags or containers for the disposal of contaminated protective clothing and equipment.

Fiber means a particulate form of asbestos, five micrometers or longer, with a length-to-diameter ratio of at least three to one.

Glove bag means not more than a 60 x 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.

High-efficiency particulate air (HEPA) filter means a filter capable of trapping and retaining at least 99.97 percent of all monodispersed particles of 0.3 micrometers mean aerodynamic diameter or larger.

WAC 296-62-07703 (Cont.)

Homogeneous area means an area of surfacing material or thermal system insulation that is uniform in color and texture.

Industrial hygienist means a professional qualified by education, training, and experience to anticipate, recognize, evaluate and develop controls for occupational health hazards.

Intact means that the ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix. Friable ACM that is disturbed, as defined in this part, is presumed to be no longer intact.

Modification for the purpose of WAC 296-62-07712 means a changed or altered procedure, material or component of a control system, which replaces a procedure, material or component of a required system. Omitting a procedure or component, or reducing or diminishing the stringency or strength of a material or component of the control system is not a "modification" for the purposes of WAC 296-62-07712.

Negative initial exposure assessment means a demonstration by the employer (which complies with the criteria in WAC 296-62-07709) that employee exposure during an operation is expected to be consistently below the PELs.

PACM means "presumed asbestos-containing material."

Presumed asbestos-containing material means thermal system insulation and surfacing material found in buildings, vessels, and vessel sections constructed no later than 1980. The designation of a material as "PACM" may be rebutted pursuant to WAC 296-62-07721.

Project designer means a person who has successfully completed the training requirements for an abatement project designer established by 40 U.S.C. 763.90(g).

Regulated area means an area established by the employer to demarcate areas where Class I, II, and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos, exceed or can reasonably be expected to exceed the permissible exposure limit. Requirements for regulated areas are set out in WAC 296-62-07711.

Removal means all operations where ACM and/or PACM is taken out or stripped from structures or substrates, and includes demolition operations.

Renovation means the modifying of any existing vessel, vessel section, structure, or portion thereof.

Repair means overhauling, rebuilding, reconstructing, or reconditioning of vessels, vessel sections, structures or substrates, including encapsulation or other repair of ACM or PACM attached to vessels, vessel sections, structures or substrates.

Surfacing material means material that is sprayed, troweled-on or otherwise applied to surfaces (such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, and other purposes).

Surfacing ACM means surfacing material which contains more than 1% asbestos.

Thermal system insulation (TSI) means ACM applied to pipes, fittings, boilers, breaching, tanks, ducts, or other structural components to prevent heat loss or gain.

Thermal system insulation ACM is thermal system insulation which contains more than 1% asbestos.

[Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07703, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07703, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 89-21-018 (Order 89-10), 296-62-07703, filed 10/10/89,

effective 11/24/89; 89-11-035 (Order 89-03), 296-62-07703, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07703, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07703, filed 4/27/87.]

WAC 296-62-07705 Permissible exposure limits (PEL).

(1) **Time weighted average (TWA).** The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter (0.1 f/cc) of air as an eight-hour time-weighted average (TWA) as determined by the method prescribed in Appendix A of this part, or by an equivalent method recognized by the department.

(2) **Excursion limit.** The employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 1.0 fiber per cubic centimeter of air (1 f/cc) as averaged over a sampling period of thirty minutes, as determined by the method prescribed in Appendix A of this part, or by an equivalent method recognized by the department.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07705, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), 296-62-07705, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07705, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07705, filed 4/27/87.]

WAC 296-62-07706 Multi-employer worksites.

(1) On multi-employer worksites, an employer performing work requiring the establishment of a regulated area shall inform other employers on the site of the nature of the employer's work with asbestos and/or PACM, of the existence of and requirements pertaining to regulated areas, and the measures taken to ensure that employees of such other employers are not exposed to asbestos.

(2) Asbestos hazards at a multi-employer worksite shall be abated by the employer who created or controls the source of asbestos contamination. For example, if there is a significant breach of an enclosure containing Class I work, the employer responsible for erecting the enclosure shall repair the breach immediately.

(3) In addition, all employers of employees exposed to asbestos hazards shall comply with applicable protective provisions to protect their employees. For example, if employees working immediately adjacent to a Class I asbestos job are exposed to asbestos due to the inadequate containment of such jobs, their employer shall either remove the employees from the area until the enclosure breach is repaired; or perform an initial exposure assessment pursuant to WAC 296-62-07709.

(4) All employers of employees working adjacent to regulated areas established by another employer on a multi-employer worksite, shall take steps on a daily basis to ascertain the integrity of the enclosure and/or the effectiveness of the control method relied on by the primary asbestos contractor to assure that asbestos fibers do not migrate to such adjacent areas.

(5) All general contractors on a construction project which includes work covered by this standard shall be deemed to exercise general supervisory authority over the work covered by this standard, even though the general contractor is not qualified to serve as the asbestos “competent person” as defined by WAC 296-62-07703. As supervisor of the entire project, the general contractor shall ascertain whether the asbestos contractor is in compliance with this standard, and shall require such contractor to come into compliance with this standard when necessary.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07706, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 94-16-145, 296-62-07706, filed 8/3/94, effective 9/12/94; 87-24-051 (Order 87-24), 296-62-07706, filed 11/30/87.]

WAC 296-62-07709 Exposure assessment and monitoring.

(1) **General monitoring criteria.**

(a) Each employer who has a workplace or work operation where exposure monitoring is required under this part must perform monitoring to determine accurately the airborne concentrations of asbestos to which employees may be exposed.

(b) Determinations of employee exposure must be made from breathing zone air samples that are representative of the eight-hour TWA and thirty minute short-term exposures of each employee.

WAC 296-62-07709 (Cont.)

(c) Representative eight-hour TWA employee exposures must be determined on the basis of one or more samples representing full-shift exposure for each shift for each employee in each job classification in each work area.

(d) Representative thirty minute short-term employee exposures must be determined on the basis of one or more samples representing thirty minute exposures associated with operations that are most likely to produce exposures above the excursion limit for each shift for each job classification in each work area.

(2) Exposure monitoring requirements for all occupational exposures to asbestos in all industries covered by the Washington Industrial Safety and Health Act except construction work, as defined in WAC 296-155-012, and except ship repairing, shipbuilding and shipbreaking employments and related employments as defined in WAC 296-304-01001.

(a) Initial monitoring.

(i) Each employer who has a workplace or work operation covered by this standard, except as provided for in (a)(ii) and (iii) of this subsection, must perform initial monitoring of employees who are, or may reasonably be expected to be exposed to airborne concentrations at or above the TWA permissible exposure limit and/or excursion limit. The initial monitoring must be at the initiation of each asbestos job to accurately determine the airborne concentration of asbestos to which employees may be exposed.

(ii) Where the employer or his/her representative has monitored after March 31, 1992, for the TWA permissible exposure limit and/or excursion limit, and the monitoring satisfies all other requirements of this section, and the monitoring data was obtained during work operations conducted under workplace conditions closely resembling the processes, type of material including percentage of asbestos, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of (a)(i) of this subsection.

(iii) Where the employer has relied upon objective data that demonstrates that asbestos is not capable of being released in airborne concentrations at or above the TWA permissible exposure limit and/or excursion limit under those work conditions of processing, use, or handling expected to have the greatest potential for releasing asbestos, then no initial monitoring is required.

(b) Monitoring frequency (periodic monitoring) and patterns. After the initial determinations required by subsection (2)(a)(i) of this section, samples must be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of the employees. Sampling must not be at intervals greater than six months for employees whose exposures may reasonably be foreseen to exceed the TWA permissible exposure limit and/or excursion limit.

(c) Daily monitoring within regulated areas: The employer must conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area. Exception: When all employees within a regulated area are equipped with full facepiece supplied-air respirators operated in the pressure-demand mode equipped with either an auxiliary positive pressure self-contained breathing apparatus or a HEPA filter, the employer may dispense with the daily monitoring required by this subsection.

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(d) Changes in monitoring frequency. If either the initial or the periodic monitoring required by subsection (2)(a) and (b) of this section statistically indicates that employee exposures are below the TWA permissible exposure limit and/or excursion limit, the employer may discontinue the monitoring for those employees whose exposures are represented by such monitoring.

(e) Additional monitoring. Notwithstanding the provisions of subsection (2)(a)(ii) and (c) of this section, the employer must institute the exposure monitoring required under subsection (2)(a)(i) and (ii) of this section whenever there has been a change in the production, process, control equipment, personnel, or work practices that may result in new or additional exposures above the TWA permissible exposure limit and/or excursion limit, or when the employer has any reason to suspect that a change may result in new or additional exposures above the TWA permissible exposure limit and/or excursion limit.

(3) Exposure assessment monitoring requirements for all construction work as defined in WAC 296-155-012 and for all ship repairing, shipbuilding and shipbreaking employments and related employments as defined in WAC 296-304-01001.

(a) Initial exposure assessment.

(i) Each employer who has a workplace or work operation covered by this standard must ensure that a "competent person" conducts an exposure assessment immediately before or at the initiation of the operation to ascertain expected exposures during that operation or workplace. The assessment must be completed in time to comply with the requirements which are triggered by exposure data or lack of a "negative exposure assessment," and to provide information necessary to assure that all control systems planned are appropriate for that operation and will work properly.

(ii) Basis of initial exposure assessment: Unless a negative exposure assessment has been made according to (b) of this subsection, the initial exposure assessment must, if feasible, be based on monitoring conducted according to (b) of this subsection. The assessment must take into consideration both the monitoring results and all observations, information or calculations which indicate employee exposure to asbestos, including any previous monitoring conducted in the workplace, or of the operations of the employer which indicate the levels of airborne asbestos likely to be encountered on the job. For Class I asbestos work, until the employer conducts exposure monitoring and documents that employees on that job will not be exposed in excess of the PELs, or otherwise makes a negative exposure assessment according to (b) of this subsection, the employer must presume that employees are exposed in excess of the TWA and excursion limit.

(b) Negative exposure assessment: For any one specific asbestos job which will be performed by employees who have been trained in compliance with the standard, the employer may demonstrate that employee exposures will be below the PELs by data which conform to the following criteria:

(i) Objective data demonstrating that the products or material containing asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the TWA and excursion limit under those work conditions having the greatest potential for releasing asbestos; or

(ii) Where the employer has monitored prior asbestos jobs for the PEL and the excursion limit within 12 months of the current or projected job, the monitoring and analysis were performed in compliance with the asbestos standard in effect; and the data was obtained during work operations conducted under workplace conditions "closely resembling" the

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processes, type of material including percentage of asbestos, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job, and these data show that under the conditions prevailing and which will prevail in the current workplace there is a high degree of certainty that employee exposures will not exceed the TWA or excursion limit; or

(iii) The results of initial exposure monitoring of the current job made from breathing zone samples that are representative of the 8-hour TWA and 30-minute short-term exposures of each employee covering operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.

(c) Periodic monitoring.

(i) Class I and Class II operations. The employer must conduct daily monitoring that is representative of the exposure of each employee who is assigned to work within a regulated area who is performing Class I or II work, unless the employer according to (b) of this subsection, has made a negative exposure assessment for the entire operation.

(ii) All operations under the standard other than Class I and II operations. The employer must conduct periodic monitoring of all work where exposures are expected to exceed a PEL, at intervals sufficient to document the validity of the exposure prediction.

(iii) Exception. When all employees required to be monitored daily are equipped with supplied-air respirators operated in the pressure demand mode, the employer may dispense with the daily monitoring required by subsection (2)(c) of this section. However, employees performing Class I work using a control method which is not listed in WAC 296-62-07712 or using a modification of a listed control method, must continue to be monitored daily even if they are equipped with supplied-air respirators.

(d) Termination of monitoring. If the periodic monitoring required by (c) of this subsection reveals that employee exposures, as indicated by statistically reliable measurements, are below the permissible exposure limit and excursion limit the employer may discontinue monitoring for those employees whose exposures are represented by such monitoring.

(e) Monitoring outside negative-pressure enclosures: The employer must conduct representative area monitoring of the airborne fiber levels at least every other day at the HEPA machine exhaust and entrance to the decontamination area.

(f) Additional monitoring. Notwithstanding the provisions of (b), (c), and (d) of this subsection, the employer must institute the exposure monitoring required under (c) of this subsection whenever there has been a change in process, control equipment, personnel or work practices that may result in new or additional exposures above the permissible exposure limit and/or excursion limit or when the employer has any reason to suspect that a change may result in new or additional exposures above the permissible exposure limit and/or excursion limit. Such additional monitoring is required regardless of whether a “negative exposure assessment” was previously produced for a specific job.

(g) Preabatement monitoring. Prior to the start of asbestos work, respresentative area monitoring must be conducted for comparison to clearance monitoring as required by subsection (3)(h) of this section. Preabatement air monitoring is not required for outdoor work.

WAC 296-62-07709 (Cont.)

(h) Clearance monitoring. Representative area air monitoring must be taken at the completion of the asbestos work. Air sample results must be obtained before removal or reoccupancy of the regulated area. Clearance air monitoring is not required for outdoor asbestos work. The employer must demonstrate by monitoring that the airborne concentration is below:

- The permissible exposure limit; or
- At or below the airborne fiber level existing prior to the start of the asbestos work, whichever level is lower.

(4) **Method of monitoring.**

(a) All samples taken to satisfy the employee exposure monitoring requirements of this section must be personal samples collected following the procedures specified in WAC 296-62-07735, Appendix A.

(b) Monitoring must be performed by persons having a thorough understanding of monitoring principles and procedures and who can demonstrate proficiency in sampling techniques.

(c) All samples taken to satisfy the monitoring requirements of this section must be evaluated using the WISHA reference method specified in WAC 296-62-07735, Appendix A, or an equivalent counting method recognized by the department.

(d) If an equivalent method to the WISHA reference method is used, the employer must ensure that the method meets the following criteria:

(i) Replicate exposure data used to establish equivalency are collected in side-by-side field and laboratory comparisons; and

(ii) The comparison indicates that ninety percent of the samples collected in the range 0.5 to 2.0 times the permissible limit have an accuracy range of plus or minus twenty-five percent of the WISHA reference method results at a ninety-five percent confidence level as demonstrated by a statistically valid protocol; and

(iii) The equivalent method is documented and the results of the comparison testing are maintained.

(e) To satisfy the monitoring requirements of this section, employers must use the results of monitoring analysis performed by laboratories which have instituted quality assurance programs that include the elements as prescribed in WAC 296-62-07735, Appendix A.

(5) **Employee notification of monitoring results.**

(a) The employer must, as soon as possible but no later than within fifteen working days after the receipt of the results of any monitoring performed under the standard, notify the affected employees of these results in writing either individually or by posting of results in an appropriate location that is accessible to affected employees.

(b) The written notification required by (a) of this subsection must contain the corrective action being taken by the employer to reduce employee exposure to or below the TWA and/or excursion exposure limits, wherever monitoring results indicated that the TWA and/or excursion exposure limits had been exceeded.

WAC 296-62-07709 (Cont.)

(6) **Observation of monitoring.**

(a) The employer must provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to asbestos conducted in accordance with this section.

(b) When observation of the monitoring of employee exposure to asbestos requires entry into an area where the use of protective clothing or equipment is required, the observer must be provided with and be required to use such clothing and equipment and shall comply with all other applicable safety and health procedures.

[Statutory Authority: RCW 49.17.010, .040, .050 and RCW 49.26.130. 00-06-075 (Order 99-40), § 296-62-07709, filed 03/01/00, effective 04/10/00. Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07709, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07709, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), 296-62-07709, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07709, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07709, filed 4/27/87.]

WAC 296-62-07711 Regulated areas.

(1) **General.** The employer shall establish a regulated area in work areas where airborne concentrations of asbestos exceed or can reasonably be expected to exceed the permissible exposure limits prescribed in WAC 296-62-07705. All Class I, II and III asbestos work shall be conducted within regulated areas. All other operations covered by this standard shall be conducted within the regulated area where airborne concentrations of asbestos exceed or can reasonably be expected to exceed permissible exposure limits. Regulated areas shall comply with the requirements of subsections (2), (3), (4), (5), (6), (7), and (8) of this section.

(2) **Demarcation.** The regulated area shall be demarcated in any manner that minimizes the number of persons within the area and protects persons outside the area from exposure to airborne asbestos. Where critical barriers or negative pressure enclosures are used, they may demarcate the regulated area. Signs shall be provided and displayed pursuant to the requirements of WAC 296-62-07721.

(3) **Access.** Access to regulated areas shall be limited to authorized persons or to persons authorized by the Washington Industrial Safety and Health Act or regulations issued pursuant thereto.

(4) **Provision of respirators.** Each person entering a regulated area where employees are required in WAC 296-62-07715(1) to wear respirators shall be supplied with and required to use a respirator, selected in accordance with WAC 296-62-07715(2).

(5) **Protective clothing.** All persons entering a regulated area shall be supplied with and required to wear protective clothing, selected in accordance with WAC 296-62-07717.

(6) **Prohibited activities.** The employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in the regulated areas.

(7) **Permit-required confined space.** The employer shall determine if a permit-required confined space hazard exists and shall take any necessary precautions in accordance with chapter 296-62 WAC Part M.

(8) **Competent persons.** For construction and shipyard work the employer shall ensure that all asbestos work performed within regulated areas is supervised by a competent person, as defined in WAC 296-62-07703. The duties of the competent person are set out in WAC 296-62-07728.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07711, filed 9/5/97, effective 11/5/97. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07711, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 95-04-007, 296-62-07711, filed 1/18/95, effective 3/1/95; 93-19-142 (Order 93-04), 296-62-07711, filed 9/22/93, effective 11/1/93; 89-11-035 (Order 89-03), 296-62-07711, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07711, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07711, filed 4/27/87.]

WAC 296-62-07712 Requirements for asbestos activities in construction and shipyard work.

(1) Methods of compliance, the following engineering controls and work practices of this section must be used for construction work defined in WAC 296-155-012 and for all ship repair defined in WAC 296-304-010.

(2) Engineering controls and work practices for all operations covered by this section. The employer must use the following engineering controls and work practices in all operations covered by this section, regardless of the levels of exposure:

(a) Vacuum cleaners equipped with HEPA filters to collect all debris and dust containing ACM and PACM, except as provided in subsection (10)(b) of this section in the case of roofing material.

(b) Wet methods, or wetting agents, to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup, except where employers demonstrate that the use of wet methods is infeasible due to, for example, the creation of electrical hazards, equipment malfunction, and, in roofing, except as provided in subsection (10)(b) of this section.

(c) Asbestos must be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet saturated state to prevent the emission of airborne fibers unless the usefulness of the product would be diminished thereby.

(d) Prompt cleanup and disposal of wastes and debris contaminated with asbestos in leak-tight containers except in roofing operations, where the procedures specified in this section apply.

(3) In addition to the requirements of subsection (2) of this section, the employer must use the following control methods to achieve compliance with the TWA permissible exposure limit and excursion limit prescribed by WAC 296-62-07705:

(a) Local exhaust ventilation equipped with HEPA filter dust collection systems;

(b) Enclosure or isolation of processes producing asbestos dust;

(c) Ventilation of the regulated area to move contaminated air away from the breathing zone of employees and toward a filtration or collection device equipped with a HEPA filter;

(d) Use of other work practices and engineering controls that the department can show to be feasible;

(e) Wherever the feasible engineering and work practice controls described above are not sufficient to reduce employee exposure to or below the permissible exposure limit and/or excursion limit prescribed in WAC 296-62-07705, the employer must use them to reduce employee exposure to the lowest levels attainable by these controls and must supplement them by the use of respiratory protection that complies with the requirements of WAC 296-62-07715.

(4) **Prohibitions.** The following work practices and engineering controls must not be used for work related to asbestos or for work which disturbs ACM or PACM, regardless of measured levels of asbestos exposure or the results of initial exposure assessments:

(a) High-speed abrasive disc saws that are not equipped with point or cut ventilator or enclosures with HEPA filtered exhaust air;

(b) Compressed air used to remove asbestos, or materials containing asbestos, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air;

(c) Dry sweeping, shoveling or other dry cleanup of dust and debris containing ACM and PACM;

(d) Employee rotation as a means of reducing employee exposure to asbestos.

WAC 296-62-07712 (Cont.)

(5) **Cleanup.**

(a) After completion of asbestos work (removal, demolition, and renovation operations), all surfaces in and around the work area must be cleared of any asbestos debris.

(b) Encapsulant must be applied to all areas where asbestos has been removed to ensure binding of any remaining fibers.

(6) **Class I requirements.** The following engineering controls and work practices and procedures must be used:

(a) All Class I work, including the installation and operation of the control system must be supervised by a competent person as defined in WAC 296-62-07703;

(b) For all Class I jobs involving the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material; for all other Class I jobs, where the employer cannot produce a negative exposure assessment according to WAC 296-62-07709(3), or where employees are working in areas adjacent to the regulated area, while the Class I work is being performed, the employer must use one of the following methods to ensure that airborne asbestos does not migrate from the regulated area:

(i) Critical barriers must be placed over all the openings to the regulated area, except where activities are performed outdoors; or

(ii) The employer must use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area surveillance during each work shift at each boundary of the regulated area, showing no visible asbestos dust; and perimeter area monitoring showing that clearance levels contained in 40 CFR Part 763, Subpart E, of the EPA Asbestos in Schools Rule are met, or that perimeter area levels, measured by Phase Contrast Microscopy (PCM) are no more than background levels representing the same area before the asbestos work began. The results of such monitoring must be made known to the employer no later than 24 hours from the end of the work shift represented by such monitoring. Exception: For work completed outdoors where employees are not working in areas adjacent to the regulated areas, (a) of this subsection is satisfied when the specific control methods in subsection (7) of this section are used;

(c) For all Class I jobs, HVAC systems must be isolated in the regulated area by sealing with a double layer of 6 mil plastic or the equivalent;

(d) For all Class I jobs, impermeable dropcloths shall be placed on surfaces beneath all removal activity;

(e) For all Class I jobs, all objects within the regulated area must be covered with impermeable dropcloths or plastic sheeting which is secured by duct tape or an equivalent;

(f) For all Class I jobs where the employer cannot produce a negative exposure assessment, or where exposure monitoring shows that a PEL is exceeded, the employer must ventilate the regulated area to move contaminated air away from the breathing zone of employees toward a HEPA filtration or collection device.

(7) **Specific control methods for Class I work.** In addition, Class I asbestos work must be performed using one or more of the following control methods according to the limitations stated below:

WAC 296-62-07712 (Cont.)

(a) Negative pressure enclosure (NPE) systems: NPE systems may be used where the configuration of the work area does not make the erection of the enclosure infeasible, with the following specifications and work practices:

(i) Specifications:

(A) The negative pressure enclosure (NPE) may be of any configuration;

(B) At least 4 air changes per hour must be maintained in the NPE;

(C) A minimum of -0.02 column inches of water pressure differential, relative to outside pressure, must be maintained within the NPE as evidenced by manometric measurements;

(D) The NPE must be kept under negative pressure throughout the period of its use; and

(E) Air movement must be directed away from employees performing asbestos work within the enclosure, and toward a HEPA filtration or collection device.

(ii) Work practices:

(A) Before beginning work within the enclosure and at the beginning of each shift, the NPE must be inspected for breaches and smoke-tested for leaks, and any leaks sealed.

(B) Electrical circuits in the enclosure must be deactivated, unless equipped with ground-fault circuit interrupters.

(b) Glove bag systems may be used to remove PACM and/or ACM from straight runs of piping and elbows and other connections with the following specifications and work practices:

(i) Specifications:

(A) Glove bags must be made of 6 mil thick plastic and must be seamless at the bottom.

(B) Glove bags used on elbows and other connections must be designed for that purpose and used without modifications.

(ii) Work practices:

(A) Each glove bag must be installed so that it completely covers the circumference of pipe or other structure where the work is to be done.

(B) Glove bags must be smoke-tested for leaks and any leaks sealed prior to use.

(C) Glove bags may be used only once and may not be moved.

(D) Glove bags must not be used on surfaces whose temperature exceeds 150^{O}F.

(E) Prior to disposal, glove bags must be collapsed by removing air within them using a HEPA vacuum.

WAC 296-62-07712 (Cont.)

(F) Before beginning the operation, loose and friable material adjacent to the glove bag/box operation must be wrapped and sealed in two layers of six mil plastic or otherwise rendered intact.

(G) Where system uses attached waste bag, such bag must be connected to collection bag using hose or other material which must withstand pressure of ACM waste and water without losing its integrity.

(H) Sliding valve or other device must separate waste bag from hose to ensure no exposure when waste bag is disconnected.

(I) At least two persons must perform Class I glove bag removal operations.

(c) Negative pressure glove bag systems. Negative pressure glove bag systems may be used to remove ACM or PACM from piping.

(i) Specifications: In addition to specifications for glove bag systems above, negative pressure glove bag systems must attach HEPA vacuum systems or other devices to bag during removal.

(ii) Work practices:

(A) The employer must comply with the work practices for glove bag systems in this section.

(B) The HEPA vacuum cleaner or other device used during removal must run continually during the operation until it is completed at which time the bag must be collapsed prior to removal of the bag from the pipe.

(C) Where a separate waste bag is used along with a collection bag and discarded after one use, the collection bag may be reused if rinsed clean with amended water before reuse.

(d) Negative pressure glove box systems: Negative pressure glove boxes may be used to remove ACM or PACM from pipe runs with the following specifications and work practices:

(i) Specifications:

(A) Glove boxes must be constructed with rigid sides and made from metal or other material which can withstand the weight of the ACM and PACM and water used during removal.

(B) A negative pressure generator must be used to create negative pressure in the system.

(C) An air filtration unit must be attached to the box.

(D) The box must be fitted with gloved apertures.

(E) An aperture at the base of the box must serve as a bagging outlet for waste ACM and water.

(F) A back-up generator must be present on site.

(G) Waste bags must consist of 6 mil thick plastic double-bagged before they are filled or plastic thicker than 6 mil.

WAC 296-62-07712 (Cont.)

(ii) Work practices:

(A) At least two persons must perform the removal.

(B) The box must be smoke-tested for leaks and any leaks sealed prior to each use.

(C) Loose or damaged ACM adjacent to the box must be wrapped and sealed in two layers of 6 mil plastic prior to the job, or otherwise made intact prior to the job.

(D) A HEPA filtration system must be used to maintain pressure barrier in box.

(e) Water spray process system. A water spray process system may be used for removal of ACM and PACM from cold line piping if, employees carrying out such process have completed a 40-hour separate training course in its use, in addition to training required for employees performing Class I work. The system must meet the following specifications and shall be performed by employees using the following work practices:

(i) Specifications:

(A) Piping must be surrounded on 3 sides by rigid framing.

(B) A 360 degree water spray, delivered through nozzles supplied by a high pressure separate water line, must be formed around the piping.

(C) The spray must collide to form a fine aerosol which provides a liquid barrier between workers and the ACM and PACM.

(ii) Work practices:

(A) The system must be run for at least 10 minutes before removal begins.

(B) All removal must take place within the water barrier.

(C) The system must be operated by at least three persons, one of whom must not perform removal, but must check equipment, and ensure proper operation of the system.

(D) After removal, the ACM and PACM must be bagged while still inside the water barrier.

(f) A small walk-in enclosure which accommodates no more than two persons (mini-enclosure) may be used if the disturbance or removal can be completely contained by the enclosure with the following specifications and work practices:

(i) Specifications:

(A) The fabricated or job-made enclosure must be constructed of 6 mil plastic or equivalent.

(B) The enclosure must be placed under negative pressure by means of a HEPA filtered vacuum or similar ventilation unit.

(C) Change room. A small change room made of 6-mil-thick polyethylene plastic should be contiguous to the mini-enclosure, and is necessary to allow the

worker to vacuum off his/her protective coveralls and remove them before leaving the

WAC 296-62-07712 (Cont.)

work area. While inside the enclosure, the worker should wear Tyvek disposable coveralls or equivalent and must use the appropriate HEPA-filtered dual cartridge respiratory protection. The advantages of mini-enclosures are that they limit the spread of asbestos contamination, reduce the potential exposure of bystanders and other workers who may be working in adjacent areas, and are quick and easy to install. The disadvantage of mini-enclosures is that they may be too small to contain the equipment necessary to create a negative-pressure within the enclosure; however, the double layer of plastic sheeting will serve to restrict the release of asbestos fibers to the area outside the enclosure.

(ii) Work practices:

(A) Before use, the mini-enclosure must be inspected for leaks and smoke-tested to detect breaches, and any breaches sealed.

(B) Before reuse, the interior must be completely washed with amended water and HEPA-vacuumed.

(C) During use, air movement must be directed away from the employee's breathing zone within the mini-enclosure.

(8) **Alternative control methods for Class I work.** Class I work may be performed using a control method which is not referenced in subsection (2)(a) through (3)(e) of this section, or which modifies a control method referenced in subsection (2)(a) through (3)(e) of this section, if the following provisions are complied with:

(a) The control method shall enclose, contain or isolate the processes or source of airborne asbestos dust, before it enters the breathing zone of employees.

(b) A certified industrial hygienist or licensed professional engineer who is also qualified as a project designer as defined in WAC 296-62-07703, shall evaluate the work area, the projected work practices and the engineering controls and shall certify in writing that the planned control method is adequate to reduce direct and indirect employee exposure to below the PELs under worst-case conditions of use, and that the planned control method will prevent asbestos contamination outside the regulated area, as measured by clearance sampling which meets the requirements of EPA's Asbestos in Schools rule issued under AHERA, or perimeter monitoring which meets the criteria in subsection (6)(b)(ii) of this section. Where the TSI or surfacing material to be removed is 25 linear or 10 square feet or less, the evaluation required in subsection (8)(b) of this section may be performed by a competent person.

(c) Before work which involves the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material is begun using an alternative method which has been the subject of subsection (2)(a) through (3)(e) of this section required evaluation and certification, the employer shall send a copy of such evaluation and certification to the Department of Labor and Industries, Asbestos Certification Program, P.O. Box 44614, Olympia, Washington 98504-4614. The submission shall not constitute approval by WISHA.

(d) The evaluation of employee exposure required in WAC 296-62-07712(8) must include and be based on sampling and analytical data representing employee exposure during the use of such method under the worst-case conditions and by employees whose training and experiences are equivalent to employees who are to perform the current job.

(9) **Work practices and engineering controls for Class II work.**

(a) All Class II work must be supervised by a competent person as defined in WAC 296-62-07703.

WAC 296-62-07712 (Cont.)

(b) For all indoor Class II jobs, where the employer has not produced a negative exposure assessment according to WAC 296-62-07709(3), or where during the job, changed conditions indicate there may be exposure above the PEL or where the employer does not remove the ACM in a substantially intact state, the employer must use one of the following methods to ensure that airborne asbestos does not migrate from the regulated area:

(i) Critical barriers must be placed over all openings to the regulated area; or

(ii) The employer must use another barrier or isolation method which prevents the migration of airborne asbestos from the regulated area, as verified by perimeter area monitoring or clearance monitoring which meets the criteria set out in subsection (6)(b)(ii) of this section.

(c) Impermeable dropcloths must be placed on surfaces beneath all removal activity.

(d) All Class II asbestos work must be performed using the work practices and requirements set out above in subsection (2) of this section.

(10) **Additional controls for Class II work.** Class II asbestos work must also be performed by complying with the work practices and controls designated for each type of asbestos work to be performed, set out in this paragraph. Where more than one control method may be used for a type of asbestos work, the employer may choose one or a combination of designated control methods. Class II work also may be performed using a method allowed for Class I work, except that glove bags and glove boxes are allowed if they fully enclose the Class II material to be removed.

(a) For removing vinyl and asphalt flooring materials which contain ACM or for which in buildings constructed no later than 1980, the employer has not verified the absence of ACM according to WAC 296-62-07712 (10)(a)(ix). The employer must ensure that employees comply with the following work practices and that employees are trained in these practices according to WAC 296-62-07722.

(i) Flooring or its backing must not be sanded.

(ii) Vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) must be used to clean floors.

(iii) Resilient sheeting must be removed by cutting with wetting of the snip point and wetting during delamination. Rip-up of resilient sheet floor material is prohibited.

(iv) All scraping of residual adhesive and/or backing must be performed using wet methods.

(v) Dry sweeping is prohibited.

(vi) Mechanical chipping is prohibited unless performed in a negative pressure enclosure which meets the requirements of subsection (7)(a) of this section.

(vii) Tiles must be removed intact, unless the employer demonstrates that intact removal is not possible.

(viii) When tiles are heated and can be removed intact, wetting may be omitted.

(ix) Resilient flooring material including associated mastic and backing must be assumed to be asbestos-containing unless an industrial hygienist determines that it is asbestos-free using recognized analytical techniques.

WAC 296-62-07712 (Cont.)

(b) For removing roofing material which contains ACM the employer must ensure that the following work practices are followed:

(i) Roofing material must be removed in an intact state to the extent feasible.

(ii) Wet methods must be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such wet methods are not feasible or will create safety hazards.

(iii) Cutting machines must be continuously misted during use, unless a competent person determines that misting substantially decreases worker safety.

(iv) When removing built-up roofs with asbestos-containing roofing felts and an aggregate surface using a power roof cutter, all dust resulting from the cutting operation must be collected by a HEPA dust collector, or must be HEPA vacuumed by vacuuming along the cut line. When removing built-up roofs with asbestos-containing roofing felts and a smooth surface using a power roof cutter, the dust resulting from the cutting operation must be collected either by a HEPA dust collector or HEPA vacuuming along the cut line, or by gently sweeping and then carefully and completely wiping up the still wet dust and debris left along the cut line. The dust and debris must be immediately bagged or placed in covered containers.

(v) Asbestos-containing material that has been removed from a roof must not be dropped or thrown to the ground. Unless the material is carried or passed to the ground by hand, it must be lowered to the ground via covered, dust-tight chute, crane or hoist:

(A) Any ACM that is not intact must be lowered to the ground as soon as is practicable, but in any event no later than the end of the work shift. While the material remains on the roof it must either be kept wet, placed in an impermeable waste bag, or wrapped in plastic sheeting.

(B) Intact ACM must be lowered to the ground as soon as is practicable, but in any event no later than the end of the work shift.

(vi) Upon being lowered, unwrapped material must be transferred to a closed receptacle in such manner so as to preclude the dispersion of dust.

(vii) Roof level heating and ventilation air intake sources shall be isolated or the ventilation system must be shut down.

(viii) Notwithstanding any other provision of this section, removal or repair of sections of intact roofing less than 25 square feet in area does not require use of wet methods or HEPA vacuuming as long as manual methods which do not render the material nonintact are used to remove the material and no visible dust is created by the removal method used. In determining whether a job involves less than 25 square feet, the employer must include all removal and repair work performed on the same roof on the same day.

(c) When removing cementitious asbestos-containing siding and shingles or transite panels containing ACM on building exteriors (other than roofs, where subsection (10)(b) of this section applies) the employer must ensure that the following work practices are followed:

(i) Cutting, abrading or breaking siding, shingles, or transite panels, must be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release cannot be used.

(ii) Each panel or shingle must be sprayed with amended water prior to removal.

WAC 296-62-07712 (Cont.)

(iii) Unwrapped or unbagged panels or shingles must be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.

(iv) Nails must be cut with flat, sharp instruments.

(d) When removing gaskets containing ACM, the employer must ensure that the following work practices are followed:

(i) If a gasket is visibly deteriorated and unlikely to be removed intact, removal must be undertaken within a glove bag as described in subsection (7)(b) of this section.

(ii) (Reserved.)

(iii) The gasket must be immediately placed in a disposal container.

(iv) Any scraping to remove residue must be performed wet.

(e) When performing any other Class II removal of asbestos-containing material for which specific controls have not been listed in subsection (10) of this section, the employer must ensure that the following work practices are complied with.

(i) The material must be thoroughly wetted with amended water prior to and during its removal.

(ii) The material must be removed in an intact state unless the employer demonstrates that intact removal is not possible.

(iii) Cutting, abrading or breaking the material must be prohibited unless the employer can demonstrate that methods less likely to result in asbestos fiber release are not feasible.

(iv) Asbestos-containing material removed, must be immediately bagged or wrapped, or kept wet until transferred to a closed receptacle, no later than the end of the work shift.

(f) Alternative work practices and controls. Instead of the work practices and controls listed in subsection (10) of this section, the employer may use different or modified engineering and work practice controls if the following provisions are complied with.

(i) The employer must demonstrate by data representing employee exposure during the use of such method under conditions which closely resemble the conditions under which the method is to be used, that employee exposure will not exceed the PELs under any anticipated circumstances.

(ii) A competent person must evaluate the work area, the projected work practices and the engineering controls, and must certify in writing, that the different or modified controls are adequate to reduce direct and indirect employee exposure to below the PELs under all expected conditions of use and that the method meets the requirements of this standard. The evaluation must include and be based on data representing employee exposure during the use of such method under conditions which closely resemble the conditions under which the method is to be used for the current job, and by employees whose training and experience are equivalent to employees who are to perform the current job.

WAC 296-62-07712 (Cont.)

(11) **Work practices and engineering controls for Class III asbestos work.** Class III asbestos work must be conducted using engineering and work practice controls which minimize the exposure to employees performing the asbestos work and to bystander employees.

(a) The work must be performed using wet methods.

(b) To the extent feasible, the work must be performed using local exhaust ventilation.

(c) Where the disturbance involves drilling, cutting, abrading, sanding, chipping, braking, or sawing of thermal system insulation or surfacing material, the employer must use impermeable dropcloths, and must isolate the operation using mini-enclosures or glove bag systems according to subsection (7) of this section or another isolation method.

(d) Where the employer does not produce a "negative exposure assessment" for a job, or where monitoring results show the PEL has been exceeded, the employer must contain the area using impermeable dropcloths and plastic barriers or their equivalent, or must isolate the operation using a control system listed in and in compliance with subsection (7) of this section.

(e) Employees performing Class III jobs, which involve the disturbance of thermal system insulation or surfacing material, or where the employer does not produce a "negative exposure assessment" or where monitoring results show a PEL has been exceeded, must wear respirators which are selected, used and fitted according to provisions of WAC 296-62-07715.

(12) **Class IV asbestos work.** Class IV asbestos jobs must be conducted by employees trained according to the asbestos awareness training program set out in WAC 296-62-07722. In addition, all Class IV jobs must be conducted in conformity with the requirements set out in this section, mandating wet methods, HEPA vacuums, and prompt clean up of debris containing ACM and PACM.

(a) Employees cleaning up debris and waste in a regulated area where respirators are required must wear respirators which are selected, used and fitted according to provisions of WAC 296-62-07715.

(b) Employers of employees who clean up waste and debris in, and employers in control of, areas where friable thermal system insulation or surfacing material is accessible, must assume that such waste and debris contain asbestos.

(13) **Alternative methods of compliance** for installation, removal, repair, and maintenance of certain roofing and pipeline coating materials. Notwithstanding any other provision of this section, an employer who complies with all provisions of subsection (10)(a) and (b) of this section when installing, removing, repairing, or maintaining intact pipeline asphaltic wrap, or roof flashings which contain asbestos fibers encapsulated or coated by bituminous or resinous compounds will be deemed to be in compliance with this section. If an employer does not comply with all provisions of this subsection (13), or if during the course of the job the material does not remain intact, the provisions of subsection (10) of this section apply instead of this subsection (13).

(a) Before work begins and as needed during the job, a competent person who is capable of identifying asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, and who has the authority to take prompt corrective measures to eliminate such hazards, must conduct an inspection of the worksite and determine that the roofing material is intact and will likely remain intact.

(b) All employees performing work covered by this subsection (13) must be trained in a training program that meets the requirements of WAC 296-62-07722.

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(c) The material must not be sanded, abraded, or ground. When manual methods are used, materials must stay intact.

(d) Material that has been removed from a roof must not be dropped or thrown to the ground. Unless the material is carried or passed to the ground by hand, it must be lowered to the ground via covered, dust-tight chute, crane or hoist. All such material must be removed from the roof as soon as is practicable, but in any event no later than the end of the work shift.

(e) Where roofing products which have been labeled as containing asbestos pursuant to WAC 296-62-07721, installed on nonresidential roofs during operations covered by this subsection (13), the employer must notify the building owner of the presence and location of such materials no later than the end of the job.

(f) All removal or disturbance of pipeline asphaltic wrap must be performed using wet methods.

[Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07712, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07712, filed 9/5/97, effective 11/5/97; 97-01-079, 296-62-07712, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 89-21-018 (Order 89-10), 296-62-07712, filed 10/10/89, effective 11/24/89; 89-11-035 (Order 89-03), 296-62-07712, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07712, filed 11/30/87.]

WAC 296-62-07713 Methods of compliance for asbestos activities in general industry.

(1) **Engineering controls and work practices.**

(a) The employer must institute engineering controls and work practices to reduce and maintain employee exposure to or below the permissible exposure limits prescribed in WAC 296-62-07705, except to the extent that such controls are not feasible. Engineering controls and work practices include but are not limited to the following:

(i) Local exhaust ventilation equipped with HEPA filter dust collection systems;

(ii) Vacuum cleaners equipped with HEPA filters;

(iii) Enclosure or isolation of processes producing asbestos dust;

(iv) Use of wet methods, wetting agents, or removal encapsulants to control employee exposures during asbestos handling, mixing, removal, cutting, application, and cleanup;

(v) Prompt disposal of wastes contaminated with asbestos in leak-tight containers; or

(vi) Use of work practices or other engineering controls that the director can show to be feasible.

(b) Wherever the feasible engineering controls and work practices that can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limits prescribed in WAC 296-62-07705, the employer must use them to reduce employee exposure to the lowest levels achievable by these controls and must supplement them by the use of respiratory protection that complies with the requirements of WAC 296-62-07715.

(c) For the following operations, wherever feasible engineering controls and work practices that can be instituted are not sufficient to reduce the employee exposure to or below the permissible exposure limits prescribed in WAC 296-62-07705, the employer must use them to reduce employee exposure to or below 0.5 fiber per cubic centimeter of air (as an eight-hour time-weighted average) or 2.5 fibers per cubic centimeter of air for 30 minutes (short-term exposure),

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and must supplement them by the use of any combination of respiratory protection that complies with the requirements of WAC 296-62-07715, work practices and feasible engineering controls that will reduce employee exposure to or below the permissible exposure limits prescribed in WAC 296-62-07705: Coupling cutoff in primary asbestos cement pipe manufacturing; sanding in primary and secondary asbestos cement sheet manufacturing; grinding in primary and secondary friction product manufacturing; carding and spinning in dry textile processes; and grinding and sanding in primary plastics manufacturing.

(d) Local exhaust ventilation. Local exhaust HEPA ventilation and dust collection systems must be designed, constructed, installed, and maintained in accordance with good practices such as those found in the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2-1979.

(e) Particular tools. All hand-operated and power-operated tools which would produce or release fibers of asbestos so as to expose employees to levels in excess of the exposure limits prescribed in WAC 296-62-07705, such as, but not limited to, saws, scorers, abrasive wheels, and drills, must be provided with local exhaust ventilation systems which comply with (d) of this subsection. High-speed abrasive disc saws that are not equipped with appropriate engineering controls must not be used for work related to asbestos.

(f) Wet methods. Asbestos must be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet saturated state to prevent the emission of airborne fibers unless the usefulness of the product would be diminished thereby.

(g) Particular products and operations. When asbestos cement, mortar, coating, grout, plaster, or similar material containing asbestos is removed from bags, cartons, or other containers in which they are shipped, it must be either wetted, enclosed, or ventilated so as to prevent effectively the release of airborne fibers of asbestos.

(h) Compressed air. Compressed air must not be used to remove asbestos or materials containing asbestos unless the compressed air is used in conjunction with an enclosed ventilation system designed to effectively capture the dust cloud created by the compressed air.

(2) **Compliance program.**

(a) Where either the time weighted average and/or excursion limit is exceeded, the employer must establish and implement a written program to reduce employee exposure to or below the permissible exposure limits by means of engineering and work practice controls as required by subsection (1) of this section, and by the use of respiratory protection where required or permitted under this section.

(b) Such programs must be reviewed and updated as necessary to reflect significant changes in the status of the employer's compliance program.

(c) Written programs must be submitted upon request for examination and copying to the director, affected employees and designated employee representatives.

(d) The employer must not use employee rotation as a means of compliance with the permissible exposure limits specified in WAC 296-62-07705.

(3) **Specific compliance methods for brake and clutch repair:**

(a) Engineering controls and work practices for brake and clutch repair and service. During automotive brake and clutch inspection, disassembly, repair and assembly operations, the employer must institute engineering controls and work practices to reduce employee exposure to

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materials containing asbestos using a negative pressure enclosure/HEPA vacuum system method or low pressure/wet cleaning method which meets the detailed requirements in WAC 296-62-07745, Appendix F. The employer may also comply using an equivalent method which follows written procedures which the employer demonstrates can achieve results equivalent to Method (1) Negative pressure enclosure/HEPA vacuum system method in WAC 296-62-07745, Appendix F. For facilities in which no more than 5 pair of brakes or 5 clutches are inspected, disassembled, repaired, or assembled per week, (4) Wet method in WAC 296-62-07745, Appendix F may be used instead of Method (1).

(b) The employer may also comply by using an equivalent method which follows written procedures, which the employer demonstrates can achieve equivalent exposure reductions as do the two "preferred methods." Such demonstration must include monitoring data conducted under workplace conditions closely resembling the process, type of asbestos containing materials, control method, work practices and environmental conditions which the equivalent method will be used, or objective data, which document that under all reasonably foreseeable conditions of brake and clutch repair applications, the method results in exposure which are equivalent to the methods in WAC 296-62-07745, Appendix F.

[Statutory Authority: RCW 49.17.010, .040, .050 and RCW 49.26.130. 00-06-075 (Order 99-40), § 296-62-07713, filed 03/01/00, effective 04/10/00. Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07713, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07713, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-07713, filed 8/13/90, effective 9/24/90; 89-11-035 (Order 89-03), 296-62-07713, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07713, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07713, filed 4/27/87.]

WAC 296-62-07715 Respiratory protection.

(1) **General.** For employees who use respirators as required by WAC 296-62-077 through 296-62-07747, the employer must provide respirators that comply with the requirements of this section. Respirators must be used during:

(a) Periods necessary to install or implement feasible engineering and work-practice controls;

(b) Work operations, such as maintenance and repair activities, for which engineering and work-practice controls are not feasible;

(c) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limits;

(d) Emergencies;

(e) Work operations in all regulated areas, except for construction activities which follow requirements set forth in WAC 296-62-07715 (1)(g);

(f) Work operations whenever employee exposure exceeds the permissible exposure limits;

(g) The following construction activities:

(i) Class I asbestos work;

(ii) Class II work where the ACM is not removed in a substantially intact state;

(iii) Class II and Class III work which is not performed using wet methods, except for removal of ACM from sloped roofs when a negative-exposure assessment has been made and the ACM is removed in an intact state;

(iv) Class II and Class III asbestos work for which a negative-exposure assessment has not been conducted;

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(v) Class III work when TSI or surfacing ACM or PACM is being disturbed;

(vi) Class IV work performed within regulated areas where employees who are performing other work are required to wear respirators.

(2) **Respirator program.**

(a) The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(b) The employer must provide a tight-fitting, powered, air-purifying respirator instead of any negative-pressure respirator specified in Table 1 of this section when an employee chooses to use this type of respirator and the respirator provides adequate protection to the employee.

(c) The employer must inform any employee required to wear a respirator under this section that the employee may require the employer to provide a tight-fitting, powered, air-purifying respirator instead of any negative-pressure respirator specified in Table 1 of this section.

(d) No employee must be assigned to tasks requiring the use of respirators if, based on their most recent medical examination, the examining physician determines that the employee will be unable to function normally using a respirator, or that the safety or health of the employee or other employees will be impaired by the use of a respirator. Such employees must be assigned to another job or given the opportunity to transfer to a different position, the duties of which they can perform. If such a transfer position is available, the position must be with the same employer, in the same geographical area, and with the same seniority, status, and rate of pay the employee had just prior to such transfer.

(3) **Respirator selection.**

(a) The employer must select and provide the appropriate respirator from Table 1 of this section, and ensure that the employee uses the respirator provided.

(b) The employer must provide a half-mask, air-purifying respirator, other than a disposable respirator, that is equipped with a high-efficiency filter when the employee performs:

(i) Class II and III asbestos work and the employer has not conducted a negative-exposure assessment;

(ii) Class III asbestos work when TSI or surfacing ACM or PACM is being disturbed.

WAC 296-62-07715 (Cont.)

TABLE 1--RESPIRATORY PROTECTION FOR ASBESTOS FIBERS

Airborne concentration of asbestos or condition of use	Required respirator (See Note a)
Not in excess of 1 f/cc (10 x PEL), or otherwise as required independent of exposure	Half-mask air-purifying respirator other than a disposable respirator, equipped with high efficiency filters. (See Note b.)
Not in excess of 5 f/cc (50 x PEL)	Full facepiece air-purifying respirator equipped with high efficiency filters.
Not in excess of 10 f/cc (100 x PEL)	Any powered air-purifying respirator equipped with high efficiency filters or any supplied-air respirator operated in continuous flow mode.
Not in excess of 100 f/cc (1,000 x PEL)	Full facepiece supplied-air respirator operated in pressure demand mode.
Greater than 100 f/cc (1,000 x PEL) or unknown concentration	Full facepiece supplied-air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus or HEPA filter egress cartridges.

Note:

a. Respirators assigned for higher environmental concentrations may be used at lower concentrations.
b. A high-efficiency filter means a filter that is capable of trapping and retaining at least 99.97 percent of all monodispersed particles of 0.3 micrometers mean aerodynamic diameter or larger.

(4) **Special respiratory protection requirements.**

(a) Unless specifically identified in this subsection, respirator selection for asbestos removal, demolition, and renovation operations shall be in accordance with Table 1 of subsection (3) of this section. The employer shall provide and require to be worn, at no cost to the employee, a full facepiece supplied-air respirator operated in the pressure demand mode equipped with either an auxiliary positive pressure self-contained breathing apparatus or a HEPA filter egress cartridge, to employees engaged in the following asbestos operations:

(i) Inside negative pressure enclosures used for removal, demolition, and renovation of friable asbestos from walls, ceilings, vessels, ventilation ducts, elevator shafts, and other structural members, but does not include pipes or piping systems; or

(ii) Any dry removal of asbestos.

(b) For all Class I work excluded or not specified in (a)(i) and (ii) of this subsection, when a negative-exposure assessment of the area has not been produced, and the exposure assessment of the area indicates the exposure level will not exceed 1 f/cc as an 8-hour time weighted average, employers must provide the employees with one of the following respirators:

(i) A tight-fitting, powered, air-purifying respirator equipped with high-efficiency filters;

(ii) A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with HEPA egress cartridges; or

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(iii) A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with an auxiliary positive-pressure self-contained breathing apparatus. A full facepiece supplied-air respirator operated in the pressure-demand mode equipped with an auxiliary positive-pressure self-contained breathing apparatus must be provided under such conditions when the exposure assessment indicates exposure levels above 1 f/cc as an 8-hour time weighted average.

Exception: *In lieu of the supplied-air respirator required by subsection (4) of this section, an employer may provide and require to be worn, at no cost to the employee, a full facepiece supplied-air respirator operated in the continuous flow mode equipped with either an auxiliary positive pressure self-contained breathing apparatus or a back-up HEPA filter egress cartridge where daily and historical personal monitoring data indicates the concentration of asbestos fibers is not reasonably expected to exceed 10 f/cc. The continuous flow respirator shall be operated at a minimum air flow rate of six cubic feet per minute at the facepiece using respirable air supplied as required by chapter 296-62 WAC, Part E.*

(5) **Respirator fit testing.**

(a) For each employee wearing negative pressure respirators, employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and at least annually thereafter. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn.

(b) Any supplied-air respirator facepiece equipped with a back-up HEPA filter egress cartridge shall be quantitatively fit tested (see WAC 296-62-07160 through 296-62-07162 and 296-62-07201 through 296-62-07248).

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07715, filed 05/04/99, effective 09/01/99.] Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07715, filed 9/5/97, effective 11/5/97; 97-01-079, 296-62-07715, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 91-03-044 (Order 90-18), 296-62-07715, filed 1/10/91, effective 2/12/91; 89-11-035 (Order 89-03), 296-62-07715, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07715, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07715, filed 4/27/87.]

WAC 296-62-07717 Protective work clothing and equipment.

(1) **Provision and use.** If an employee is exposed to asbestos above the permissible exposure limits, or where the possibility of eye irritation exists, or for which a required negative exposure assessment is not produced and for any employee performing Class I operations, the employer shall provide at no cost to the employee and require that the employee uses appropriate protective work clothing and equipment such as, but not limited to:

(a) Coveralls or similar full-body work clothing;

(b) Gloves, head coverings, and foot coverings; and

(c) Face shields, vented goggles, or other appropriate protective equipment which complies with WAC 296-800-160.

(2) **Removal and storage.**

(a) The employer shall ensure that employees remove work clothing contaminated with asbestos only in change rooms provided in accordance with WAC 296-62-07719(1).

(b) The employer shall ensure that no employee takes contaminated work clothing out of the change room, except those employees authorized to do so for the purpose of laundering, maintenance, or disposal.

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(c) Contaminated clothing. Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and be labeled in accordance with WAC 296-62-07721.

(d) Containers of contaminated protective devices or work clothing which are to be taken out of change rooms or the workplace for cleaning, maintenance, or disposal, shall bear labels in accordance with WAC 296-62-07721(6).

(3) **Cleaning and replacement.**

(a) The employer shall clean, launder, repair, or replace protective clothing and equipment required by this paragraph to maintain their effectiveness. The employer shall provide clean protective clothing and equipment at least weekly to each affected employee.

(b) The employer shall prohibit the removal of asbestos from protective clothing and equipment by blowing or shaking.

(c) Laundering of contaminated clothing shall be done so as to prevent the release of airborne fibers of asbestos in excess of the permissible exposure limits prescribed in WAC 296-62-07705.

(d) Any employer who gives contaminated clothing to another person for laundering shall inform such person of the requirement in (c) of this subsection to effectively prevent the release of airborne fibers of asbestos in excess of the permissible exposure limits.

(e) The employer shall inform any person who launders or cleans protective clothing or equipment contaminated with asbestos of the potentially harmful effects of exposure to asbestos.

(f) Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable containers, and labeled in accordance with WAC 296-62-07721.

(4) **Inspection of protective clothing for construction and shipyard work.**

(a) The competent person shall examine worksuits worn by employees at least once per workshift for rips or tears that may occur during performance of work.

(b) When rips or tears are detected while an employee is working, rips and tears shall be immediately mended, or the worksuit shall be immediately replaced.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07717, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07717, filed 9/5/97, effective 11/5/97; 97-01-079, 296-62-07717, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-07717, filed 7/20/94, effective 9/20/94; 89-11-035 (Order 89-03), 296-62-07717, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07717, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07717, filed 4/27/87.]

WAC 296-62-07719 Hygiene facilities and practices.

(1) **Change rooms.**

(a) The employer shall provide clean change rooms for employees required to work in regulated areas or required by WAC 296-62-07717(1) to wear protective clothing.

Exception: *In lieu of the change area requirement specified in this subsection, the employer may permit employees in Class III and Class IV asbestos work, to clean their protective clothing with a portable HEPA-equipped vacuum before such employees leave the area where maintenance was performed.*

(b) The employer shall ensure that change rooms are in accordance with WAC 296-24-120, and are equipped with two separate lockers or storage facilities, so separated as to prevent contamination of the employee's street clothes from his/her protective work clothing and equipment.

WAC 296-62-07719 (Cont.)

(2) **Showers.**

(a) The employer shall ensure that employees who work in negative pressure enclosures required by WAC 296-62-07712, or who work in areas where their airborne exposure is above the permissible exposure limits prescribed in WAC 296-62-07705, shower at the end of the work shift.

(b) The employer shall provide shower facilities which comply with WAC 296-24-12010.

(c) The employer shall ensure that employees who are required to shower pursuant to (a) of this subsection do not leave the workplace wearing any clothing or equipment worn during the work shift.

(3) Special requirements in addition to the other provisions of WAC 296-62-07719 for construction work defined in WAC 296-155-012 and for all shipyard work defined in WAC 296-304-010.

(a) Requirements for employees performing Class I asbestos jobs involving over 25 linear or 10 square feet of TSI or surfacing ACM and PACM.

(i) Decontamination areas: The employer shall establish a decontamination area that is adjacent and connected to the regulated area for the decontamination of such employees. The decontamination area shall consist of an equipment room, shower area, and clean room in series. The employer shall ensure that employees enter and exit the regulated area through the decontamination area.

(A) Equipment room. The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective equipment.

(B) Shower area. Shower facilities shall be provided which comply with WAC 296-24-12010, unless the employer can demonstrate that they are not feasible. The showers shall be adjacent both to the equipment room and the clean room, unless the employer can demonstrate that this location is not feasible. Where the employer can demonstrate that it is not feasible to locate the shower between the equipment room and the clean room, or where the work is performed outdoors, the employers shall ensure that employees:

(I) Remove asbestos contamination from their worksuits in the equipment room using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or

(II) Remove their contaminated worksuits in the equipment room, then don clean worksuits, and proceed to a shower that is not adjacent to the work area.

(C) Clean change room. The clean room shall be equipped with a locker or appropriate storage container for each employee's use.

(ii) Decontamination area entry procedures. The employer shall ensure that employees:

(A) Enter the decontamination area through the clean room;

(B) Remove and deposit street clothing within a locker provided for their use; and

(C) Put on protective clothing and respiratory protection before leaving the clean room.

WAC 296-62-07719 (Cont.)

(D) Before entering the regulated area, the employer shall ensure that employees pass through the equipment room.

(iii) Decontamination area exit procedures. The employer shall ensure that:

(A) Before leaving the regulated area, employees shall remove all gross contamination and debris from their protective clothing;

(B) Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers;

(C) Employees shall not remove their respirators in the equipment room;

(D) Employees shall shower prior to entering the clean room. When taking a shower, employees shall be fully wetted, including the face and hair, prior to removing the respirators;

(E) After showering, employees shall enter the clean room before changing into street clothes.

(b) Requirements for Class I work involving less than 25 linear or 10 square feet of TSI or surfacing ACM and PACM, and for Class II and Class III asbestos work operations where exposures exceed a PEL or where there is no negative exposure assessment produced before the operation.

(i) The employer shall establish an equipment room or area that is adjacent to the regulated area for the decontamination of employees and their equipment which is contaminated with asbestos which shall consist of an area covered by a impermeable drop cloth on the floor or horizontal working surface.

(ii) The area must be of sufficient size as to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area (as determined by visible accumulations).

(iii) Work clothing must be cleaned with a HEPA vacuum before it is removed.

(iv) All equipment and surfaces of containers filled with ACM must be cleaned prior to removing them from the equipment room or area.

(v) The employer shall ensure that employees enter and exit the regulated area through the equipment room or area.

(c) Requirements for Class IV work. Employers shall ensure that employees performing Class IV work within a regulated area comply with hygiene practice required of employees performing work which has a higher classification within that regulated area. Otherwise employers of employees cleaning up debris and material which is TSI or surfacing ACM or identified as PACM shall provide decontamination facilities for such employees which are required by WAC 296-62-07719 (3)(b).

(d) Decontamination area for personnel shall not be used for the transportation of asbestos debris.

(e) Waste load-out procedure. The waste load-out area as required by WAC 296-62-07723 shall be used as an area for final preparation and external decontamination of waste containers, as a short term storage area for bagged waste, and as a port for transporting waste. The employer shall ensure waste containers be free of all gross contaminated material before removal from the

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negative-pressure enclosure. Gross contamination shall be wiped, scraped off, or washed off containers before they are placed into a two chamber air lock which is adjacent to the negative-pressure enclosure. In the first chamber, the exterior of the waste container shall be decontaminated or placed within a second waste container, and then it shall be moved into the second chamber of the air lock for temporary storage or transferred outside of the regulated area. The second waste container shall not be reused unless thoroughly decontaminated.

(4) **Lunchrooms.**

(a) The employer shall provide lunchroom facilities for employees who work in areas where their airborne exposure is above the time weighted average and/or excursion limit.

(b) The employer shall ensure that lunchroom facilities have a positive pressure, filtered air supply, and are readily accessible to employees.

(c) The employer shall ensure that employees who work in areas where their airborne exposure is above the time weighted average and/or excursion limit, wash their hands and faces prior to eating, drinking, or smoking.

(d) The employer shall ensure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface asbestos fibers have been removed from the clothing or equipment by vacuuming or other method that removes dust without causing the asbestos to become airborne.

(5) Smoking in work areas. The employer shall ensure that employees do not smoke in work areas where they are occupationally exposed to asbestos because of activities in that work area.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07719, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 91-03-044 (Order 90-18), 296-62-07719, filed 1/10/91, effective 2/12/91; 89-11-035 (Order 89-03), 296-62-07719, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07719, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07719, filed 4/27/87.]

WAC 296-62-07721 Communication of hazards to employees.

(1) **Communication of hazards to employees.** General industry requirements.

(a) Introduction. This section applies to the communication of information concerning asbestos hazards in general industry. Asbestos exposure in industry occurs in a wide variety of industrial and commercial settings. Employees who manufacture asbestos-containing products may be exposed to asbestos fibers. Employees who repair and replace automotive brakes and clutches may be exposed to asbestos fibers. In addition, employees engaged in housekeeping activities in industrial facilities with asbestos product manufacturing operations, and in public and commercial buildings with installed asbestos-containing materials may be exposed to asbestos fibers. It should be noted that employees who perform housekeeping activities during and after construction activities are covered by asbestos construction work requirements in WAC 296-62-077. Housekeeping employees, regardless of industry designation, should know whether building components they maintain may expose them to asbestos. Building owners are often the only and/or best source of information concerning the presence of previously installed asbestos-containing building materials. Therefore they, along with employers of potentially exposed employees, are assigned specific information conveying and retention duties under this section.

(b) Installed asbestos-containing material. Employers and building owners are required to treat installed TSI and sprayed-on and troweled-on surfacing materials as ACM for the purposes of this standard. These materials are designated "presumed ACM or PACM," and are defined in WAC 296-62-07703. Asphalt and vinyl flooring installed no later than 1980 also must be treated as asbestos-containing. The employer or building owner may demonstrate that PACM and flooring materials do not contain asbestos by complying with WAC 296-62-07712 (10)(a)(ix).

WAC 296-62-07721 (Cont.)

(c) Duties of employers and building and facility owners.

(i) Building and facility owners must determine the presence, location, and quantity of ACM and/or PACM at the worksite. Employers and building and facility owners must exercise due diligence in complying with these requirements to inform employers and employees about the presence and location of ACM and PACM.

(ii) Before authorizing or allowing any construction, renovation, remodeling, maintenance, repair, or demolition project, an owner or owner's agent must perform, or cause to be performed, a good faith inspection to determine whether materials to be worked on or removed contain asbestos. The inspection must be documented by a written report maintained on file and made available upon request to the director.

(A) The good faith inspection must be conducted by an accredited inspector.

(B) Such good faith inspection is not required if the owner or owner's agent is reasonably certain that asbestos will not be disturbed by the project or the owner or owner's agent assumes that the suspect material contains asbestos and handles the material in accordance with WAC 296-62-07701 through 296-62-07753.

(iii) The owner or owner's agent must provide, to all contractors submitting a bid to undertake any construction, renovation, remodeling, maintenance, repair, or demolition project, the written statement either of the reasonable certainty of nondisturbance of asbestos or of assumption of the presence of asbestos. Contractors must be provided with the written report before they apply or bid to work.

(iv) Any owner or owner's agent who fails to comply with (c)(ii) and (iii) of this subsection must be subject to a mandatory fine of not less than two hundred fifty dollars for each violation. Each day the violation continues must be considered a separate violation. In addition, any construction, renovation, remodeling, maintenance, repair, or demolition which was started without meeting the requirements of this section must be halted immediately and cannot be resumed before meeting such requirements.

(v) Building and facility owners must inform employers of employees, and employers must inform employees who will perform housekeeping activities in areas which contain ACM and/or PACM of the presence and location of ACM and/or PACM in such areas which may be contacted during such activities.

(vi) Upon written or oral request, building or facility owners must make a copy of the written report required in this section available to the department of labor and industries and the collective bargaining representatives or employee representatives of any employee who may be exposed to any asbestos or asbestos-containing materials. A copy of the written report must be posted conspicuously at the location where employees report to work.

(vii) Building and facility owners must maintain records of all information required to be provided according to this section and/or otherwise known to the building owner concerning the presence, location and quantity of ACM and PACM in the building/facility. Such records must be kept for the duration of ownership and must be transferred to successive owners.

(2) **Communication of hazards to employees.** Requirements for construction and shipyard employment activities.

WAC 296-62-07721 (Cont.)

(a) Introduction. This section applies to the communication of information concerning asbestos hazards in construction and shipyard employment activities. Most asbestos-related construction and shipyard activities involve previously installed building materials. Building/vessel owners often are the only and/or best sources of information concerning them. Therefore, they, along with employers of potentially exposed employees, are assigned specific information conveying and retention duties under this section. Installed Asbestos Containing Building/Vessel Material: Employers and building/vessel owners must identify TSI and sprayed or troweled on surfacing materials as asbestos-containing unless the employer, by complying with WAC 296-62-07721(3) determines it is not asbestos containing. Asphalt or vinyl flooring/decking material installed in buildings or vessels no later than 1980 must also be considered as asbestos containing unless the employer/owner, according to WAC 296-62-07712 (10)(a)(ix) determines it is not asbestos containing. If the employer or building/vessel owner has actual knowledge or should have known, through the exercise of due diligence, that materials other than TSI and sprayed-on or troweled-on surfacing materials are asbestos containing, they must be treated as such. When communicating information to employees according to this standard, owners and employers must identify "PACM" as ACM. Additional requirements relating to communication of asbestos work on multi-employer worksites are set out in WAC 296-62-07706.

(b) Duties of building/vessel and facility owners.

(i) Before work subject to this section is begun, building/vessel and facility owners must identify the presence, location and quantity of ACM, and/or PACM at the work site. All thermal system insulation and sprayed on or troweled on surfacing materials in buildings/vessels or substrates constructed no later than 1980 must be identified as PACM. In addition, resilient flooring/decking material installed no later than 1980 must also be identified as asbestos containing.

(ii) Before authorizing or allowing any construction, renovation, remodeling, maintenance, repair, or demolition project, a building/vessel and facility owner or owner's agent must perform, or cause to be performed, a good faith inspection to determine whether materials to be worked on or removed contain asbestos. The inspection must be documented by a written report maintained on file and made available upon request to the director.

(A) The good faith inspection must be conducted by an accredited inspector.

(B) Such good faith inspection is not required if the building/vessel and facility owner or owner's agent assumes that the suspect material contains asbestos and handles the material in accordance with WAC 296-62-07701 through 296-62-07753 or if the owner or the owner's agent is reasonably certain that asbestos will not be disturbed by the project.

(iii) The building/vessel and facility owner or owner's agent must provide, to all contractors submitting a bid to undertake any construction, renovation, remodeling, maintenance, repair, or demolition project, the written statement either of the reasonable certainty of nondisturbance of asbestos or of assumption of the presence of asbestos. Contractors must be provided the written report before they apply or bid on work.

(iv) Any building/vessel and facility owner or owners agent who fails to comply with WAC 296-62-07721 (2)(b)(ii) and (iii) must be subject to a mandatory fine of not less than two hundred fifty dollars for each violation. Each day the violation continues must be considered a separate violation. In addition, any construction, renovation, remodeling, maintenance, repair, or demolition which was started without meeting the requirements of this section must be halted immediately and cannot be resumed before meeting such requirements.

WAC 296-62-07721 (Cont.)

(v) Upon written or oral request, building/vessel and facility owner or owner's agent must make a copy of the written report required in this section available to the department of labor and industries and the collective bargaining representatives or employee representatives of any employee who may be exposed to any asbestos or asbestos-containing materials. A copy of the written report must be posted conspicuously at the location where employees report to work.

(vi) Building/vessel and facility owner or owner's agent must notify in writing the following persons of the presence, location and quantity of ACM or PACM, at work sites in their buildings/facilities/vessels.

(A) Prospective employers applying or bidding for work whose employees reasonably can be expected to work in or adjacent to areas containing such material;

(B) Employees of the owner who will work in or adjacent to areas containing such material;

(C) On multi-employer worksites, all employers of employees who will be performing work within or adjacent to areas containing such materials;

(D) Tenants who will occupy areas containing such materials.

(c) Duties of employers whose employees perform work subject to this standard in or adjacent to areas containing ACM and PACM. Building/vessel and facility owner or owner's agents whose employees perform such work must comply with these provisions to the extent applicable.

(i) Before work subject to this standard is begun, building/vessel and facility owner or owner's agents must determine the presence, location, and quantity of ACM and/or PACM at the work site according to WAC 296-62-07721 (2)(b).

(ii) Before work under this standard is performed employers of employees who will perform such work must inform the following persons of the location and quantity of ACM and/or PACM present at the work site and the precautions to be taken to insure that airborne asbestos is confined to the area.

(A) Owners of the building/vessel or facility;

(B) Employees who will perform such work and employers of employees who work and/or will be working in adjacent areas;

(iii) Upon written or oral request, a copy of the written report required in this section must be made available to the department of labor and industries and the collective bargaining representatives or employee representatives of any employee who may be exposed to any asbestos or asbestos-containing materials. A copy of the written report must be posted conspicuously at the location where employees report to work.

(iv) Within 10 days of the completion of such work, the employer whose employees have performed work subject to this standard, must inform the building/vessel or facility owner and employers of employees who will be working in the area of the current location and quantity of PACM and/or ACM remaining in the former regulated area and final monitoring results, if any.

WAC 296-62-07721 (Cont.)

(d) In addition to the above requirements, all employers who discover ACM and/or PACM on a work site must convey information concerning the presence, location and quantity of such newly discovered ACM and/or PACM to the owner and to other employers of employees working at the work site, within 24 hours of the discovery.

(e) No contractor may commence any construction, renovation, remodeling, maintenance, repair, or demolition project without receiving a copy of the written response or statement required by WAC 296-62-07721 (2)(b). Any contractor who begins any project without the copy of the written report or statement will be subject to a mandatory fine of not less than two hundred fifty dollars per day. Each day the violation continues will be considered a separate violation.

(3) **Criteria to rebut the designation of installed material as PACM.**

(a) At any time, an employer and/or building/vessel owner may demonstrate, for purposes of this standard, that PACM does not contain asbestos. Building/vessel owners and/or employers are not required to communicate information about the presence of building material for which such a demonstration according to the requirements of (b) of this subsection has been made. However, in all such cases, the information, data and analysis supporting the determination that PACM does not contain asbestos, must be retained according to WAC 296-62-07727.

(b) An employer or owner may demonstrate that PACM does not contain asbestos by the following:

(i) Having a completed inspection conducted according to the requirements of AHERA (40 CFR Part 763, Subpart E) which demonstrates that the material is not ACM;

(ii) Performing tests of the material containing PACM which demonstrate that no asbestos is present in the material. Such tests must include analysis of bulk samples collected in the manner described in 40 CFR 763.86, Asbestos-containing materials in schools. The tests, evaluation and sample collection must be conducted by an accredited inspector. Analysis of samples must be performed by persons or laboratories with proficiency demonstrated by current successful participation in a nationally recognized testing program such as the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute for Standards and Technology (NIST) or the Round Robin for bulk samples administered by the American Industrial Hygiene Associate (AIHA), or an equivalent nationally recognized Round Robin testing program.

(4) At the entrance to mechanical rooms/areas in which employees reasonably can be expected to enter and which contain TSI or surfacing ACM and PACM, the building/vessel and facility owner or owner's agent must post signs which identify the material which is present, its location, and appropriate work practices which, if followed, will ensure that ACM and/or PACM will not be disturbed. The employer shall ensure, to the extent feasible, that employees who come in contact with these signs can comprehend them. Means to ensure employee comprehension may include the use of foreign languages, pictographs, graphics, and awareness training.

(5) **Warning signs.**

(a) Warning signs that demarcate the regulated area must be provided and displayed at each location where a regulated area is required. In addition, warning signs must be posted at all approaches to regulated areas and be posted at such a distance from such a location that an employee may read the signs and take necessary protective steps before entering the area marked by the signs.

(b) The warning signs required by (a) of this subsection must bear the following information:

WAC 296-62-07721 (Cont.)

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

(c) The employer shall ensure that employees working in and contiguous to regulated areas comprehend the warning signs required to be posted by (a) of this subsection. Means to ensure employee comprehension may include the use of foreign languages, pictographs, and graphics.

(6) **Warning labels.**

(a) Warning labels must be affixed to all products containing asbestos including raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, and to their containers including waste containers. Installed asbestos products must contain a visible label, except where such a label would clearly not be feasible.

(b) Labels must be printed in large, bold letters on a contrasting background.

(c) The labels must comply with the requirements of WAC 296-800-170, and must include the following information:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD
AVOID BREATHING AIRBORNE ASBESTOS FIBERS

(7) The provisions for labels required by subsection (6)(a) of this section or for material safety data sheets required by subsection (8) of this section do not apply where:

(a) Asbestos fibers have been modified by a bonding agent, coating, binder, or other material, provided that the manufacturer can demonstrate that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of fibers of asbestos in excess of the excursion limit will be released; or

(b) Asbestos is present in a product in concentrations less than 1.0 percent by weight.

(8) **Material safety data sheets.** Employers who are manufacturers or importers of asbestos, or asbestos products must comply with the requirements regarding development of material safety data sheets as specified in WAC 296-62-05413, except as provided by subsection (7) of this section.

(9) When a building/vessel owner/or employer identifies previously installed PACM and/or ACM, labels or signs must be affixed or posted so that employees will be notified of what materials contain PACM and/or ACM. The employer must attach such labels in areas where they will clearly be noticed by employees who are likely to be exposed, such as at the entrance to mechanical rooms/areas. Signs required by subsection (5)(a) of this section may be posted in lieu of labels so long as they contain information required for labeling. The employer must ensure, to the extent feasible, that employees who come in contact with these signs can comprehend them. Means to ensure employee comprehension may include the use of foreign languages, pictographs, graphics, and awareness training.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-07721, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07721, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07721, filed 9/5/97, effective 11/5/97; 97-01-079, 296-62-07721, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 93-01-005 (Order 92-20), 296-62-07721, filed 12/2/92, effective 1/15/93; 91-03-044 (Order 90-18), 296-62-07721, filed 1/10/91, effective 2/12/91; 89-21-018 (Order 89-10), 296-62-07721, filed 10/10/89, effective 11/24/89; 89-11-035 (Order 89-03), 296-62-

07721, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 96-62-07721, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07721, filed 4/27/87.]

WAC 296-62-07722 Employee information and training.

(1) **Certification.**

(a) Only certified asbestos workers may work on an asbestos project as required in WAC 296-65-010 and 296-65-030.

(b) Only certified asbestos supervisors may supervise asbestos abatement projects as required in WAC 296-65-012 and 296-65-030.

(c) In cases where certification requirements of chapter 296-65 WAC do not apply, all employees must be trained according to the provisions of this section regardless of their exposure levels.

(d) Certification is not required for asbestos work on materials containing less than one percent asbestos.

(2) Training must be provided prior to or at the time of initial assignment, unless the employee has received equivalent training within the previous twelve months, and at least annually thereafter.

(3) **Asbestos projects.**

(a) Class I and must be considered an asbestos project. Only certified asbestos workers may do this work.

(b) Only certified workers may conduct Class II asbestos work that is considered an asbestos project.

(i) The following Class II asbestos work must be considered asbestos projects:

(A) All Class II asbestos work where critical barriers, equivalent isolation methods, or negative pressure enclosures are required; or

(B) All Class II asbestos work where asbestos containing materials do not stay intact (including removal of vinyl asbestos floor (VAT) or roofing materials by mechanical methods such as chipping, grinding, or sanding).

(ii) The following Class II asbestos work is not considered an asbestos project and is excluded from asbestos worker certification:

(A) All Class II asbestos work involving intact asbestos containing materials (for example, intact roofing materials, bituminous or asphalt pipeline coatings, and intact flooring/decking materials);

(B) All Class II asbestos work of less than one square foot of asbestos containing materials; or

(C) All Class II asbestos work involving asbestos-cement water pipe when the work is done in accordance with training approved by the department through the asbestos certification program (see WAC 296-65-015(4)).

(iii) Asbestos work involving the removal of one square foot or more of intact roofing materials by mechanical sawing or heavy equipment must meet the following requirements:

(A) Only certified asbestos workers may conduct mechanical sawing of intact roofing material;

(B) Noncertified asbestos workers may handle roofing dust, material and debris;

WAC 296-62-07722 (Cont.)

(C) Operators of heavy equipment (such as track hoes with clam shells and excavators) do not need to be certified asbestos workers in the removal or demolition of intact roofing materials.

(c) Only certified asbestos workers may conduct all Class III and Class IV asbestos work that is considered an asbestos project.

(i) The following asbestos work is considered an asbestos project:

(A) All Class III asbestos work where one square foot or more of asbestos containing materials that do not stay intact;

(B) All Class IV asbestos work where one square foot or more of asbestos containing materials that do not stay intact; or

(C) All Class III and Class IV asbestos work with pipe insulation.

(ii) Except for a project involving pipe insulation work, any project involving only Class III or Class IV asbestos work with less than one square foot of asbestos containing materials is not considered an asbestos project.

(4) Training requirements for asbestos work that is not considered an asbestos project or is excluded from asbestos worker certification.

(a) Class II asbestos work.

(i) Employers must provide eight-hours of training to employees who perform asbestos work on one generic category of asbestos containing materials (ACM). When performing asbestos work in more than one category of asbestos containing materials, additional training must be used to supplement the first eight hour training course.

(ii) The training course must include:

- Hands-on training that applies to the category of asbestos containing materials,
- Specific work practices and engineering controls related to the category of asbestos containing materials present as specified in WAC 296-62-07712, and
- All the minimum elements of subsection (5) of this section.

(b) Class III asbestos work (maintenance and custodial work in buildings containing asbestos containing materials).

(i) Employers must provide training with curriculum and training methods equivalent to the 16-hour operations and maintenance course developed by the EPA. (See 40 CFR 763.92(a)(2).) For those employees whose only affected work is Class II work as described in subsection (4)(a)(i) of this section, employers must meet this 16-hour training requirement or provide training that meets the eight hours Class II requirements in subsection (4)(a) of this section.

(ii) Sixteen hours of training must include:

- Hands-on training in the use of respiratory protection and work practices, and
- All the minimum elements of subsection (5) of this section.

(c) Class IV asbestos work (maintenance and custodial work in buildings containing asbestos-containing materials).

WAC 296-62-07722 (Cont.)

(i) Employers must provide at least two hours of training with curriculum and training methods equivalent to the awareness training course developed by the EPA.

(ii) Training must include:

- Available information concerning the location of PACM, ACM, asbestos-containing flooring materials or flooring materials where the absence of asbestos has not been certified,
- Instruction on how to recognize damaged, deteriorated, and delimitation of asbestos containing building materials, and
- All of the minimum elements of subsection (5) of this section.

(5) The training program must be conducted in a manner which the employee is able to understand. The employer must ensure that each employee is informed of the following:

(a) The health effects associated with asbestos exposure;

(b) The relationship between smoking and exposure to asbestos producing lung cancer;

(c) Methods of recognizing asbestos and quantity, location, manner of use, release (including the requirements of WAC 296-62-07721 (1)(c) and (2)(b) to presume certain building materials contain asbestos), and storage of asbestos and the specific nature of operations which could result in exposure to asbestos;

(d) The engineering controls and work practices associated with the employee's job assignment;

(e) The specific procedures implemented to protect employees from exposure to asbestos, such as appropriate work practices, housekeeping procedures, hygiene facilities, decontamination procedures, emergency and clean-up procedures (including where Class III and IV work is performed, the contents "Managing Asbestos In Place" (EPA 20T-2003, July 1990) or its equivalent in content), personal protective equipment to be used, waste disposal procedures, and any necessary instructions in the use of these controls and procedures;

(f) The purpose, proper use, and limitations of protective clothing;

(g) The purpose and a description of the medical surveillance program required by WAC 296-62-07725;

(h) The content of this standard, including appendices;

(i) The names, addresses and phone numbers of public health organizations which provide information, materials, and/or conduct programs concerning smoking cessation. The employer may distribute the list of such organizations contained in Appendix I, to comply with this requirement;

(j) The requirements for posting signs and affixing labels and the meaning of the required legends for such signs and labels; and

(k) The purpose, proper use, limitations, and other training requirements for respiratory protection as required by chapter 296-62 WAC, Part E (see WAC 296-62-07117, 296-62-07172, and 296-62-07186 through 296-62-07190).

(6) The employer must also provide, at no cost to employees who perform housekeeping operations in a facility which contains ACM or PACM, an asbestos awareness training course to all employees who are or

will work in areas where ACM and/or PACM is present who work in buildings containing asbestos-containing materials, which must, at a minimum, contain the following elements:

WAC 296-62-07722 (Cont.)

- Health effects of asbestos,
- Locations of ACM and PACM in the building/facility,
- Recognition of ACM and PACM damage and deterioration,
- Requirements in this standard relating to housekeeping, and
- Proper response to fiber release episodes.

Each such employee must be so trained at least once a year.

(7) **Access to information and training materials.**

(a) The employer must make a copy of this standard and its appendices readily available without cost to all affected employees.

(b) The employer must provide, upon request, all materials relating to the employee information and training program to the director.

(c) The employer must inform all employees concerning the availability of self-help smoking cessation program material. Upon employee request, the employer must distribute such material, consisting of NIH Publication No. 89-1647, or equivalent self-help material, which is approved or published by a public health organization listed in Appendix I, WAC 296-62-07751.

[Statutory Authority: RCW 49.17.010, .040, .050 and RCW 49.26.130. 00-06-075 (Order 99-40), § 296-62-07722, filed 03/01/00, effective 04/10/00. Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07722, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07222, filed 05/04/99, effective 09/01/99.] Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07722, filed 12/17/96, effective 3/1/97.]

WAC 296-62-07723 Housekeeping.

(1) All surfaces shall be maintained as free as practicable of accumulations of dusts and waste containing asbestos.

(2) All spills and sudden releases of material containing asbestos shall be cleaned up as soon as possible.

(3) Surfaces contaminated with asbestos may not be cleaned by the use of compressed air.

(4) **Vacuuming.** HEPA-filtered vacuuming equipment shall be used for vacuuming. The equipment shall be used and emptied in a manner which minimizes the reentry of asbestos into the workplace.

(5) **Shoveling,** dry sweeping, and dry clean-up of asbestos may be used only where vacuuming and/or wet cleaning are not feasible.

(6) **Waste disposal.** Waste, scrap, debris, bags, containers, equipment, and clothing contaminated with asbestos consigned for disposal, shall be collected and disposed of in sealed impermeable bags, or other closed, impermeable containers. To avoid breakage, bags shall be at least six mils in thickness and shall not be dragged or slid across rough or abrasive surfaces.

(7) **Waste removal.** Whenever a negative-pressure enclosure is required by WAC 296-62-07712, the employer wherever feasible, shall establish a waste-load-out area that is adjacent and connected to the negative-pressure enclosure, constructed of a two chamber air lock, for the decontamination and removal of asbestos debris.

(8) **Deterioration.** Asbestos and asbestos containing material which has become damaged or deteriorated shall be repaired, enclosed, encapsulated, or removed.

(9) **Care of asbestos-containing flooring/decking material.**

WAC 296-62-07723 (Cont.)

(a) Sanding of asbestos-containing floor/deck material is prohibited.

(b) Stripping of finishes shall be conducted using low abrasion pads at speeds lower than 300 rpm and wet methods.

(c) Burnishing or dry buffing may be performed only on asbestos-containing flooring/decking which has sufficient finish so that the pad cannot contact the asbestos-containing material.

(d) Dust and debris in an area containing TSI or surfacing ACM/PACM or visibly deteriorated ACM, shall not be dusted or swept dry, or vacuumed without using a HEPA filter.

(10) Waste and debris and accompanying dust in an area containing accessible thermal system insulation or surfacing material or visibly deteriorated ACM:

(a) Shall not be dusted or swept dry, or vacuumed without using a HEPA filter;

(b) Shall be promptly cleaned up and disposed of in leak tight containers.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07723, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-07723, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07723, filed 4/27/87.]

WAC 296-62-07725 Medical surveillance.

(1) **General.**

(a) Employees covered. The employer shall institute a medical surveillance program for all employees who are or will be exposed to airborne concentrations of fibers of asbestos at or above the permissible exposure limits. Exception.

Employers in the construction or shipyard industries shall institute a medical surveillance program for all employees who for a combined total of 30 or more days per year are engaged in Class I, II, and III work, or are exposed at or above the permissible exposure limit for combined 30 days or more per year; or who are required by the standard to wear negative pressure respirators. For the purpose of this subsection, any day in which an employee engaged in Class II or III work or a combination thereof for one hour or less (taking into account the entire time spent on the removal operation, including cleanup), and, while doing so adheres to the work practices specified in this standard, shall not be counted.

(b) Examination by a physician.

(i) The employer shall ensure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and shall be provided without cost to the employee and at a reasonable time and place.

(ii) Persons other than licensed physicians, who administer the pulmonary function testing required by this section, shall complete a training course in spirometry sponsored by an appropriate academic or professional institution.

(2) **Preplacement examinations.**

(a) Except as provided by WAC 296-62-07725 (1)(a), before an employee is assigned to an occupation exposed to airborne concentrations of asbestos, a preplacement medical examination shall be provided or made available by the employer. Examinations administered using the thirty or more days per year criteria of WAC 296-62-07725 (1)(a) shall be given within ten working

days following the thirtieth day of exposure. Examinations must be given prior to assignment of employees to areas where negative-pressure respirators are worn.

WAC 296-62-07725 (Cont.)

(b) All examinations shall include, as a minimum, a medical and work history: A complete physical examination of all systems with special emphasis on the pulmonary, cardiovascular, and gastrointestinal systems; completion of the respiratory disease standardized questionnaire in WAC 296-62-07741, Appendix D, Part 1; a chest roentgenogram (posterior-anterior 14x17 inches); pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV1.0); and any additional tests deemed appropriate by the examining physician. Interpretation and classification of chest roentgenograms shall be conducted in accordance with WAC 296-62-07743, Appendix E.

(3) **Periodic examinations.**

(a) Periodic medical examinations shall be made available annually.

(b) The scope of the medical examination shall be in conformance with the protocol established in subsection (2)(b) of this section, except that the frequency of chest roentgenograms shall be conducted in accordance with Table 2 of this section, and the abbreviated standardized questionnaire contained in WAC 296-62-07741, Appendix D, Part 2, shall be administered to the employee.

TABLE 2--FREQUENCY OF CHEST ROENTGENOGRAMS

Year since first exposure	Age of employee		
	15 to 35	**35+ to 45**	**45+**
0 to 10	Every 5 years	Every 5 years	Every 5 years
10+	Every 5 years	Every 2 years	Every 1 year

(c) If the examining physician determines that any of the examinations should be provided more frequently than specified, the employer shall provide such examinations to affected employees at the frequencies specified by the physician.

(4) **Termination of employment examinations.**

(a) The employer shall provide, or make available, a termination of employment medical examination for any employee who has been exposed to airborne concentrations of fibers of asbestos at or above the permissible exposure limits.

(b) The medical examination shall be in accordance with the requirements of the periodic examinations stipulated in subsection (3) of this section, and shall be given within thirty calendar days before or after the date of termination of employment.

(5) Recent examinations. No medical examination is required of any employee, if adequate records show that the employee has been examined in accordance with subsection (2), (3), or (4) of this section within the past one-year period.

(6) **Information provided to the physician.** The employer shall provide the following information to the examining physician:

(a) A copy of this standard and Appendices D, E, and H of WAC 296-62-07741, 296-62-07743, and 296-62-07749 respectively.

(b) A description of the affected employee's duties as they relate to the employee's exposure.

(c) The employee's representative exposure level or anticipated exposure level.

(d) A description of any personal protective and respiratory equipment used or to be used.

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(e) Information from previous medical examinations of the affected employee that is not otherwise available to the examining physician.

(7) **Physician's written opinion.**

(a) The employer shall obtain a written signed opinion from the examining physician. This written opinion shall contain the results of the medical examination and shall include:

(i) The physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of material health impairment from exposure to asbestos;

(ii) Any recommended limitations on the employee or upon the use of personal protective equipment such as clothing or respirators;

(iii) A statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions resulting from asbestos exposure that require further explanation or treatment; and

(iv) A statement that the employee has been informed by the physician of the increased risk of lung cancer attributable to the combined effect of smoking and asbestos exposure.

(b) The employer shall instruct the physician not to reveal in the written opinion given to the employer specific findings or diagnoses unrelated to occupational exposure to asbestos.

(c) The employer shall provide a copy of the physician's written opinion to the affected employee within thirty days from its receipt.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07725, filed 9/5/97, effective 11/5/97; 97-01-079, 296-62-07725, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 91-03-044 (Order 90-18), 296-62-07725, filed 1/10/91, effective 2/12/91; 89-11-035 (Order 89-03), 296-62-07725, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07725, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07725, filed 4/27/87.]

WAC 296-62-07727 Recordkeeping.

(1) **Exposure measurements.**

(a) The employer shall keep an accurate record of all measurements taken to monitor employee exposure to asbestos as prescribed in WAC 296-62-07709.

(b) This record shall include at least the following information:

(i) Name of employer;

(ii) Name of person conducting monitoring;

(iii) The date of measurement;

(iv) Address of operation or activity;

(v) Description of the operation or activity involving exposure to asbestos that is being monitored;

(vi) Personal or area sample;

(vii) Name, Social Security number, and exposure level of the employees whose exposures are represented;

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(viii) Type of protective devices worn, if any;

(ix) Pump calibration date and flow rate;

(x) Total volume of air sampled;

(xi) Name and address of analytical laboratory;

(xii) Number, duration, and results (f/cc) of samples taken;

(xiii) Date of analysis; and

(xiv) Sampling and analytical methods used and evidence of their accuracy.

(c) The employer shall maintain this record for the duration of employment plus thirty years, in accordance with WAC 296-62-052.

(2) **Objective data for exempted operations.**

(a) Where the processing, use, or handling of products made from or containing asbestos is exempted from other requirements of this section under WAC 296-62-07709 (2)(a)(iii) and (3)(b)(i), the employer shall establish and maintain an accurate record of objective data reasonably relied upon in support of the exemption.

(b) The record shall include at least the following:

(i) The product qualifying for exemption;

(ii) The source of the objective data;

(iii) The testing protocol, results of testing, and/or analysis of the material for the release of asbestos;

(iv) A description of the operation exempted and how the data support the exemption; and

(v) Other data relevant to the operations, materials, processing, or employee exposures covered by the exemption.

(c) The employer shall maintain this record for the duration of the employer's reliance upon such objective data.

Note: The employer may utilize the services of competent organizations such as industry trade associations and employee associations to maintain the records required by this section.

(3) **Medical surveillance.**

(a) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance by WAC 296-62-07725 (1)(a), in accordance with WAC 296-62-052.

(b) The record shall include at least the following information:

(i) The name and Social Security number of the employee;

(ii) Physician's written opinions;

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(iii) Any employee medical complaints related to exposure to asbestos;

(iv) A copy of the information provided to the physician as required by WAC 296-62-07725(6); and

(v) A copy of the employee's medical examination results, including the medical history, questionnaire responses, results of any tests, and physicians recommendations.

(c) The employer shall ensure that this record is maintained for the duration of employment plus thirty years, in accordance with WAC 296-62-052.

(4) **Training.** The employer shall maintain all employee training records for one year beyond the last date of employment of that employee.

(5) **Availability.**

(a) The employer, upon written request, shall make all records required to be maintained by this section available to the director for examination and copying.

(b) The employer, upon request, shall make any exposure records required by subsection (1) of this section available for examination and copying to affected employees, former employees, designated representatives, and the director, in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217.

(c) The employer, upon request, shall make employee medical records required by subsection (2) of this section available for examination and copying to the subject employee, to anyone having the specific written consent of the subject employee, and the director, in accordance with WAC 296-62-052.

(6) **Transfer of records.**

(a) The employer shall comply with the requirements concerning transfer of records set forth in WAC 296-62-05215.

(b) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the director at least ninety days prior to disposal of records and, upon request, transmit them to the director.

(7) **Data to rebut PACM.** Where the building owner and employer have relied on data to demonstrate that PACM is not asbestos-containing, such data shall be maintained for as long as they are relied upon to rebut the presumption.

(8) **Records of required notifications.** Where the building owner has communicated and received information concerning the identification, location and quantity of ACM and PACM, written records of such notifications and their content shall be maintained by the building owner for the duration of ownership and shall be transferred to successive owners of such buildings/facilities.

[Statutory Authority: RCW 49.17.010, .040, .050 and RCW 49.26.130. 00-06-075 (Order 99-40), § 296-62-07727, filed 03/01/00, effective 04/10/00. Statutory Authority: Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07727, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-07727, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07727, filed 4/27/87.]

WAC 296-62-07728 Competent person.

(1) **General.** For all construction and shipyard work covered by this standard, the employer must designate a competent person, having the qualifications and authorities for ensuring worker safety and health as required by chapter 296-155 WAC.

WAC 296-62-07728 (Cont.)

(2) **Required inspections by the competent person.** WAC 296-155-110(9) which requires health and safety prevention programs to provide for frequent and regular inspections on the job sites, materials, and equipment to be made by the competent person, is incorporated.

(3) **Additional inspections.** In addition, the competent person must make frequent and regular inspections of the job sites in order to perform the duties set out below in this section. For Class I jobs, on-site inspections must be made at least once during each work shift, and at any time at employee request. For Class II and III jobs, on-site inspections must be made at intervals sufficient to assess whether conditions have changed, and at any reasonable time at employee request.

(4) On all worksites where employees are engaged in Class I or II asbestos work, the competent person designated in accordance with WAC 296-62-07712 must perform or supervise the following duties, as applicable:

(a) Set up the regulated area, enclosure, or other containment;

(b) Ensure (by on-site inspection) the integrity of the enclosure or containment;

(c) Set up procedures to control entry and exit from the enclosure and/or area;

(d) Supervise all employee exposure monitoring required by this section and ensure that it is conducted as required by WAC 296-62-07709;

(e) Ensure that employees working within the enclosure and/or using glovebags wear protective clothing and respirators as required by WAC 296-62-07715 and 296-62-07717;

(f) Ensure through on-site supervision, that employees set up and remove engineering controls, use work practices and personal protective equipment in compliance with all requirements;

(g) Ensure that employees use the hygiene facilities and observe the decontamination procedures specified in WAC 296-62-07719;

(h) Ensure that through on-site inspection engineering controls are functioning properly and employees are using proper work practices; and

(i) Ensure that notification requirements in WAC 296-62-07721 are met.

(5) **Training for competent person.**

(a) For Class I and II asbestos work the competent person must be trained in all aspects of asbestos removal and handling, including:

- Abatement,
- Installation,
- Removal and handling,
- The contents of this standard,
- The identification of asbestos,
- Removal procedures where appropriate, and
- Other practices for reducing the hazard.

Such training must be the certified asbestos supervisor training specified in WAC 296-65-003, 296-65-012, and 296-65-030.

(b) For Class III and IV asbestos work:

WAC 296-62-07728 (Cont.)

(i) The competent person must be certified as an asbestos supervisor as prescribed in WAC 296-65-012 and 296-65-030 for Class III and IV work involving an asbestos project of 3 square feet or 3 linear feet or more of asbestos containing material.

(ii) For Class III and IV asbestos work involving less than 3 square feet or 3 linear feet of asbestos containing material, the competent person must be trained in:

- Aspects of asbestos handling appropriate for the nature of the work, to include procedures for setting up glove bags and mini-enclosures.
- Practices for reducing asbestos exposures.
- Use of wet methods,
- The contents of this standard, and
- The identification of asbestos.

Such training must include successful completion of a course equivalent in curriculum and training method to the 16-hour Operations and Maintenance course developed by EPA for maintenance and custodial workers (see 40 CFR 763.92 (a)(2)) or its equivalent in stringency, content and length.

[Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07728, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-19-014, 296-62-07728, filed 9/5/97, effective 11/5/97; 97-01-079, 296-62-07728, filed 12/17/96, effective 3/1/97.]

WAC 296-62-07733 Appendices.

(1) Appendices A, D, E, and F to this part are incorporated as part of this section and the contents of these appendices are mandatory.

(2) Appendices B, G, H, I, J and K to this part are informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-07733, filed 05/04/99, effective 09/01/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07733, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 91-03-044 (Order 90-18), 296-62-07733, filed 1/10/91, effective 2/12/91; 87-24-051 (Order 87-24), 296-62-07733, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07733, filed 4/27/87.]

WAC 296-62-07735 Appendix A--WISHA reference method--Mandatory.

This mandatory appendix specifies the procedure for analyzing air samples for asbestos, tremolite, anthophyllite, and actinolite and specifies quality control procedures that must be implemented by laboratories performing the analysis. The sampling and analytical methods described below represent the elements of the available monitoring methods (such as Appendix B to this section, the most current version of the WISHA method ID-60, or the most current version of the NIOSH 7400 method) which WISHA considers to be essential to achieve adequate employee exposure monitoring while allowing employers to use methods that are already established within their organizations. All employers who are required to conduct air monitoring under WAC 296-62-07709 are required to utilize analytical laboratories that use this procedure, or an equivalent method, for collecting and analyzing samples.

(1) **Sampling and analytical procedure.**

(a) The sampling medium for air samples must be mixed cellulose ester filter membranes. These must be designated by the manufacturer as suitable for asbestos, tremolite, anthophyllite, and actinolite counting. See below for rejection of blanks.

(b) The preferred collection device is the 25-mm diameter cassette with an open-faced 50-mm electrically conductive extension cowl. The 37-mm cassette may be used if necessary but only if written justification for the need to use the 37-mm filter cassette accompanies the sample results in

the employee's exposure monitoring record. Do not reuse or reload cassettes for asbestos sample collection.

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(c) An air flow rate between 0.5 liter/min and 4.0 liters/min must be selected for the 25-mm cassette. If the 37-mm cassette is used, an air flow rate between 1 liter/min and 4.0 liters/min must be selected.

(d) Where possible, a sufficient air volume for each air sample must be collected to yield between one hundred and one thousand three hundred fibers per square millimeter on the membrane filter. If a filter darkens in appearance or if loose dust is seen on the filter, a second sample must be started.

(e) Ship the samples in a rigid container with sufficient packing material to prevent dislodging the collected fibers. Packing material that has a high electrostatic charge on its surface (e.g., expanded polystyrene) cannot be used because such material can cause loss of fibers to the sides of the cassette.

(f) Calibrate each personal sampling pump before and after use with a representative filter cassette installed between the pump and the calibration devices.

(g) Personal samples must be taken in the "breathing zone" of the employee (i.e., attached to or near the collar or lapel near the worker's face).

(h) Fiber counts must be made by positive phase contrast using a microscope with an 8 to 10 X eyepiece and a 40 to 45 X objective for a total magnification of approximately 400 X and a numerical aperture of 0.65 to 0.75. The microscope shall also be fitted with a green or blue filter.

(i) The microscope must be fitted with a Walton-Beckett eyepiece graticule calibrated for a field diameter of one hundred micrometers (+/-2 micrometers).

(j) The phase-shift detection limit of the microscope must be about 3 degrees measured using the HSE phase shift test slide as outlined below.

(i) Place the test slide on the microscope stage and center it under the phase objective.

(ii) Bring the blocks of grooved lines into focus.

Note: The slide consists of seven sets of grooved lines (ca. 20 grooves to each block) in descending order of visibility from sets one to seven, seven being the least visible. The requirements for asbestos, tremolite, anthophyllite, and actinolite counting are that the microscope optics must resolve the grooved lines in set three completely, although they may appear somewhat faint, and that the grooved lines in sets six and seven must be invisible. Sets four and five must be at least partially visible but may vary slightly in visibility between microscopes. A microscope that fails to meet these requirements has either too low or too high a resolution to be used for asbestos, tremolite, anthophyllite, and actinolite counting.

(iii) If the image deteriorates, clean and adjust the microscope optics. If the problem persists, consult the microscope manufacturer.

(k) Each set of samples taken will include ten percent blanks or a minimum of two blanks. These blanks must come from the same lot as the filters used for sample collection. The field blank results must be averaged and subtracted from the analytical results before reporting. Any samples represented by a blank having a fiber count in excess of the detection limit of the method being used must be rejected.

(l) The samples must be mounted by the acetone/triacetin method or a method with an equivalent index of refraction and similar clarity.

(m) Observe the following counting rules.

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(i) Count only fibers equal to or longer than five micrometers. Measure the length of curved fibers along the curve.

(ii) Count all particles as asbestos, tremolite, anthophyllite, and actinolite that have a length-to-width ratio (aspect ratio) of three to one or greater.

(iii) Fibers lying entirely within the boundary of the Walton-Beckett graticule field must receive a count of one. Fibers crossing the boundary once, having one end within the circle, must receive the count of one-half. Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area.

(iv) Count bundles of fibers as one fiber unless individual fibers can be identified by observing both ends of an individual fiber.

(v) Count enough graticule fields to yield 100 fibers. Count a minimum of 20 fields; stop counting at 100 fields regardless of fiber count.

(n) Blind recounts must be conducted at the rate of ten percent.

(2) **Quality control procedures.**

(a) Intralaboratory program. Each laboratory and/or each company with more than one microscopist counting slides must establish a statistically designed quality assurance program involving blind recounts and comparisons between microscopists to monitor the variability of counting by each microscopist and between microscopists. In a company with more than one laboratory, the program must include all laboratories and must also evaluate the laboratory-to-laboratory variability.

(b) Interlaboratory program.

(i) Each laboratory analyzing asbestos, tremolite, anthophyllite, and actinolite samples for compliance determination shall implement an interlaboratory quality assurance program that as a minimum includes participation of at least two other independent laboratories. Each laboratory must participate in round robin testing at least once every six months with at least all the other laboratories in its interlaboratory quality assurance group. Each laboratory must submit slides typical of its own work load for use in this program. The round robin shall be designed and results analyzed using appropriate statistical methodology.

(ii) All laboratories should participate in a national sample testing scheme such as the Proficiency Analytical Testing Program (PAT), the Asbestos Registry sponsored by the American Industrial Hygiene Association (AIHA).

(c) All individuals performing asbestos, tremolite, anthophyllite, and actinolite analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos, tremolite, anthophyllite, and actinolite dust or an equivalent course, recognized by the department.

(d) When the use of different microscopes contributes to differences between counters and laboratories, the effect of the different microscope must be evaluated and the microscope must be replaced, as necessary.

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(e) Current results of these quality assurance programs must be posted in each laboratory to keep the microscopists informed.

[Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07735, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07735, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-07735, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07735, filed 4/27/87.]

WAC 296-62-07737 Appendix B--Detailed procedure for asbestos sampling and analysis--Nonmandatory.

Air Matrix:

WISHA Permissible Exposure Limits:

Time Weighted Average	0.1 fiber/cc
Excursion Level (30 minutes)	1.0 fiber/cc

Collection Procedure:

A known volume of air is drawn through a 25-mm diameter cassette containing a mixed-cellulose ester filter. The cassette must be equipped with an electrically conductive 50-mm extension cowl. The sampling time and rate are chosen to give a fiber density of between 100 to 1,300 fibers/mm^2 on the filter.

Recommended Sampling Rate 0.5 to 4.0 liters/minute (L/min)

Recommended Air Volumes:

Minimum	25 L
Maximum	2,400 L

Analytical Procedure: A portion of the sample filter is cleared and prepared for asbestos fiber counting by Phase Contrast Microscopy (PCM) at 400X. Commercial manufacturers and products mentioned in this method are for descriptive use only and do not constitute endorsements by WISHA. Similar products from other sources can be substituted.

Introduction.

This method describes the collection of airborne asbestos fibers using calibrated sampling pumps with mixed-cellulose ester (MCE) filters and analysis by phase contrast microscopy (PCM). Some terms used are unique to this method and are defined below:

Asbestos: A term for naturally occurring fibrous minerals. Asbestos includes chrysotile, crocidolite, amosite (cummingtonite-grunerite asbestos), tremolite asbestos, actinolite asbestos, anthophyllite asbestos, and any of these minerals that have been chemically treated and/or altered. The precise chemical formulation of each species will vary with the location from which it was mined. Nominal compositions are listed:

Chrysotile	$Mg_3Si_2O_5(OH)_4$
Crocidolite	$Na_2Fe_3^{2+}Fe_2^{3+}Si_8O_{22}(OH)_2$
Amosite	$(Mg,Fe)_7Si_8O_{22}(OH)_2$

Tremolite-actinolite	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$

WAC 296-62-07737 (Cont.)

Anthophyllite $(Mg,Fe)_7Si_8O_{22}(OH)_2$

Asbestos Fiber: A fiber of asbestos which meets the criteria specified below for a fiber.

Aspect Ratio: The ratio of the length of a fiber to it's diameter (e.g. 3:1, 5:1 aspect ratios).

Cleavage Fragments: Mineral particles formed by comminution of minerals, especially those characterized by parallel sides and a moderate aspect ratio (usually less than 20:1).

Detection Limit: The number of fibers necessary to be 95% certain that the result is greater than zero.

Differential Counting: The term applied to the practice of excluding certain kinds of fibers from the fiber count because they do not appear to be asbestos.

Fiber: A particle that is 5 µm or longer, with a length-to-width ratio of 3 to 1 or longer.

Field: The area within the graticule circle that is superimposed on the microscope image.

Set: The samples which are taken, submitted to the laboratory, analyzed, and for which, interim or final result reports are generated.

Tremolite, Anthophyllite, and Actinolite: The non-asbestos form of these minerals which meet the definition of a fiber. It includes any of these minerals that have been chemically treated and/or altered.

Walton-Beckett Graticule: An eyepiece graticule specifically designed for asbestos fiber counting. It consists of a circle with a projected diameter of 100 ±2 µm (area of about 0.00785 mm^2) with a crosshair having tic-marks at 3-µm intervals in one direction and 5-µm in the orthogonal direction. There are marks around the periphery of the circle to demonstrate the proper sizes and shapes of fibers. The disk is placed in one of the microscope eyepieces so that the design is superimposed on the field of view.

1. **History.**

(a) Early surveys to determine asbestos exposures were conducted using impinger counts of total dust with the counts expressed as million particles per cubic foot. The British Asbestos Research Council recommended filter membrane counting in 1969. In July 1969, the Bureau of Occupational Safety and Health published a filter membrane method for counting asbestos fibers in the United States. This method was refined by NIOSH and published as P & CAM 239. On May 29, 1971, OSHA specified filter membrane sampling with phase contrast counting for evaluation of asbestos exposures at work sites in the United States. The use of this technique was again required by OSHA in 1986. Phase contrast microscopy has continued to be the method of choice for the measurement of occupational exposure to asbestos.

(b) Principle. Air is drawn through a MCE filter to capture airborne asbestos fibers. A wedge shaped portion of the filter is removed, placed on a glass microscope slide and made transparent. A measured area (field) is viewed by PCM. All the fibers meeting a defined criteria for asbestos are counted and considered a measure of the airborne asbestos concentration.

(c) Advantages and Disadvantages

(i) There are four main advantages of PCM over other methods:

(A) The technique is specific for fibers. Phase contrast is a fiber counting technique which excludes non-fibrous particles from the analysis.

(B) The technique is inexpensive and does not require specialized knowledge to carry out the analysis for total fiber counts.

WAC 296-62-07737 (Cont.)

(C) The analysis is quick and can be performed on-site for rapid determination of air concentrations of asbestos fibers.

(D) The technique has continuity with historical epidemiological studies so that estimates of expected disease can be inferred from long-term determinations of asbestos exposures.

(ii) The main disadvantage of PCM is that it does not positively identify asbestos fibers. Other fibers which are not asbestos may be included in the count unless differential counting is performed. This requires a great deal of experience to adequately differentiate asbestos from non-asbestos fibers. Positive identification of asbestos must be performed by polarized light or electron microscopy techniques. A further disadvantage of PCM is that the smallest visible fibers are about 0.2 µm in diameter while the finest asbestos fibers may be as small as 0.02 µm in diameter. For some exposures, substantially more fibers may be present than are actually counted.

(d) Workplace Exposure. Asbestos is used by the construction industry in such products as shingles, floor tiles, asbestos cement, roofing felts, insulation and acoustical products. Non-construction uses include brakes, clutch facings, paper, paints, plastics, and fabrics. One of the most significant exposures in the workplace is the removal and encapsulation of asbestos in schools, public buildings, and homes. Many workers have the potential to be exposed to asbestos during these operations. About 95% of the asbestos in commercial use in the United States is chrysotile. Crocidolite and amosite make up most of the remainder. Anthophyllite and tremolite or actinolite are likely to be encountered as contaminants in various industrial products.

(e) Physical Properties. Asbestos fiber possesses a high tensile strength along its axis, is chemically inert, non-combustible, and heat resistant. It has a high electrical resistance and good sound absorbing properties. It can be weaved into cables, fabrics or other textiles, and also matted into asbestos papers, felts, or mats.

2. **Range and Detection Limit.**

(a) The ideal counting range on the filter is 100 to 1,300 fibers/mm^2. With a Walton-Beckett graticule this range is equivalent to 0.8 to 10 fibers/field. Using NIOSH counting statistics, a count of 0.8 fibers/field would give an approximate coefficient of variation (CV) of 0.13.

(b) The detection limit for this method is 4.0 fibers per 100 fields or 5.5 fibers/mm^2. This was determined using an equation to estimate the maximum CV possible at a specific concentration (95% confidence) and a Lower Control Limit of zero. The CV value was then used to determine a corresponding concentration from historical CV vs fiber relationships. As an example:

Lower Control Limit (95% Confidence) = AC-1.645(CV)(AC)

Where:

AC	=	Estimate of the airborne fiber concentration (fibers/cc)
		Setting the Lower Control Limit = 0 and solving for CV:
0	=	AC-1.645(CV)(AC)
CV	=	0.61

This value was compared with CV vs. count curves. The count at which CV = 0.61 for Leidel-Busch counting statistics 8(i) or for an OSHA Salt Lake Technical Center (OSHA-SLTC) CV curve (see Appendix A for further information) was 4.4 fibers or 3.9 fibers per 100 fields, respectively. Although a lower detection limit of 4 fibers per 100 fields is supported by the OSHA-SLTC data, both data sets support the 4.5 fibers per 100 fields value.

WAC 296-62-07737 (Cont.)

3. **Method Performance--Precision and Accuracy.** Precision is dependent upon the total number of fibers counted and the uniformity of the fiber distribution on the filter. A general rule is to count at least 20 and not more than 100 fields. The count is discontinued when 100 fibers are counted, provided that 20 fields have already been counted. Counting more than 100 fibers results in only a small gain in precision. As the total count drops below 10 fibers, an accelerated loss of precision is noted. At this time, there is no known method to determine the absolute accuracy of the asbestos analysis. Results of samples prepared through the Proficiency Analytical Testing (PAT) Program and analyzed by the OSHA-SLTC showed no significant bias when compared to PAT reference values. The PAT samples were analyzed from 1987 to 1989 (N = 36) and the concentration range was from 120 to 1,300 fibers/mm^2.

4. **Interferences.** Fibrous substances, if present, may interfere with asbestos analysis. Some common fibers are:

Fiber glass	Perlite veins.
Anhydrite plant fibers gypsum	Some synthetic fibers.
Membrane structures	Sponge spicules and diatoms.
Microorganisms	Wollastonite.

The use of electron microscopy or optical tests such as polarized light, and dispersion staining may be used to differentiate these materials from asbestos when necessary.

5. **Sampling.**

(a) Equipment.

(i) Sample assembly. Conductive filter holder consisting of a 25-mm diameter, 3-piece cassette having a 50-mm long electrically conductive extension cowl. Backup pad, 25-mm, cellulose. Membrane filter, mixed-cellulose ester (MCE), 25-mm, plain, white, 0.8- to 1.2-µm pore size.

Notes:

(A) DO NOT RE-USE CASSETTES.

(B) Fully conductive cassettes are required to reduce fiber loss to the sides of the cassette due to electrostatic attraction.

(C) Purchase filters which have been selected by the manufacturer for asbestos counting or analyze representative filters for fiber background before use. Discard the filter lot if more than 5 fibers/100 fields are found.

(D) To decrease the possibility of contamination, the sampling system (filter-backup pad-cassette) for asbestos is usually preassembled by the manufacturer.

(ii) Gel bands for sealing cassettes.

(iii) Sampling pump. Each pump must be a battery operated, self-contained unit small enough to be placed on the monitored employee and not interfere with the work being performed. The pump must be capable of sampling at 2.5 liters per minute (L/min) for the required sampling time.

(iv) Flexible tubing, 6-mm bore.

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(v) Pump calibration. Stopwatch and bubble tube/burette or electronic meter.

(b) Sampling Procedure.

(i) Seal the point where the base and cowl of each cassette meet with a gel band or tape.

(ii) Charge the pumps completely before beginning.

(iii) Connect each pump to a calibration cassette with an appropriate length of 6-mm bore plastic tubing. Do not use luer connectors--the type of cassette specified above has built-in adapters.

(iv) Select an appropriate flow rate for the situation being monitored. The sampling flow rate must be between 0.5 and 4.0 L/min for personal sampling and is commonly set between 1 and 2 L/min. Always choose a flow rate that will not produce overloaded filters.

(v) Calibrate each sampling pump before and after sampling with a calibration cassette in-line (Note: This calibration cassette should be from the same lot of cassettes used for sampling). Use a primary standard (e.g. bubble burette) to calibrate each pump. If possible, calibrate at the sampling site.

Note: If sampling site calibration is not possible, environmental influences may affect the flow rate. The extent is dependent on the type of pump used. Consult with the pump manufacturer to determine dependence on environmental influences. If the pump is affected by temperature and pressure changes, use the formula in subsection (10) of this section to calculate the actual flow rate.

(vi) Connect each pump to the base of each sampling cassette with flexible tubing. Remove the end cap of each cassette and take each air sample open face. Assure that each sample cassette is held open side down in the employee's breathing zone during sampling. The distance from the nose/mouth of the employee to the cassette should be about 10 cm. Secure the cassette on the collar or lapel of the employee using spring clips or other similar devices.

(vii) A suggested minimum air volume when sampling to determine TWA compliance is 25 L. For Excursion Limit (30 min sampling time) evaluations, a minimum air volume of 48 L is recommended.

(viii) The most significant problem when sampling for asbestos is overloading the filter with non-asbestos dust. Suggested maximum air sample volumes for specific environments are:

Environment	Air Vol. (L)
Asbestos removal operations (visible dust)	100
Asbestos removal operations (little dust)	240
Office environments	400 to 2,400

Caution: Do not overload the filter with dust. High levels of non-fibrous dust particles may obscure fibers on the filter and lower the count or make counting impossible. If more than about 25 to 30% of the field area is obscured with dust, the result may be biased low. Smaller air volumes may be necessary when there is excessive non-asbestos dust in the air. While sampling, observe the filter with a small flashlight. If there is a visible layer of dust on the filter, stop sampling, remove and

seal the cassette, and replace with a new sampling assembly. The total dust loading should not exceed 1 mg.

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(ix) Blank samples are used to determine if any contamination has occurred during sample handling. Prepare two blanks for the first 1 to 20 samples. For sets containing greater than 20 samples, prepare blanks as 10% of the samples. Handle blank samples in the same manner as air samples with one exception: Do not draw any air through the blank samples. Open the blank cassette in the place where the sample cassettes are mounted on the employee. Hold it open for about 30 seconds. Close and seal the cassette appropriately. Store blanks for shipment with the sample cassettes.

(x) Immediately after sampling, close and seal each cassette with the base and plastic plugs. Do not touch or puncture the filter membrane as this will invalidate the analysis.

(xi) Attach a seal (OSHA-21 or equivalent) around each cassette in such a way as to secure the end cap plug and base plug. Tape the ends of the seal together since the seal is not long enough to be wrapped end-to-end. Also wrap tape around the cassette at each joint to keep the seal secure.

(c) Sample Shipment.

(i) Send the samples to the laboratory with paperwork requesting asbestos analysis. List any known fibrous interferences present during sampling on the paperwork. Also, note the workplace operation(s) sampled.

(ii) Secure and handle the samples in such that they will not rattle during shipment nor be exposed to static electricity. Do not ship samples in expanded polystyrene peanuts, vermiculite, paper shreds, or excelsior. Tape sample cassettes to sheet bubbles and place in a container that will cushion the samples without rattling.

(iii) To avoid the possibility of sample contamination, always ship bulk samples in separate mailing containers.

6. **Analysis.**

(a) Safety Precautions.

(i) Acetone is extremely flammable and precautions must be taken not to ignite it. Avoid using large containers or quantities of acetone. Transfer the solvent in a ventilated laboratory hood. Do not use acetone near any open flame. For generation of acetone vapor, use a spark free heat source.

(ii) Any asbestos spills should be cleaned up immediately to prevent dispersal of fibers. Prudence should be exercised to avoid contamination of laboratory facilities or exposure of personnel to asbestos. Asbestos spills should be cleaned up with wet methods and/or a High Efficiency Particulate-Air (HEPA) filtered vacuum.

Caution: *Do not use a vacuum without a HEPA filter--It will disperse fine asbestos fibers in the air.*

(b) Equipment.

(i) Phase contrast microscope with binocular or trinocular head.

(ii) Widefield or Huygenian 10X eyepieces (NOTE: The eyepiece containing the graticule must be a focusing eyepiece. Use a 40X phase objective with a numerical aperture of 0.65 to 0.75).

(iii) Kohler illumination (if possible) with green or blue filter.

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(iv) Walton-Beckett Graticule, type G-22 with 100 ±2 µm projected diameter.

(v) Mechanical stage. A rotating mechanical stage is convenient for use with polarized light.

(vi) Phase telescope.

(vii) Stage micrometer with 0.01-mm subdivisions.

(viii) Phase-shift test slide, mark II (Available from PTR optics Ltd., and also McCrone).

(ix) Precleaned glass slides, 25 mm X 75 mm. One end can be frosted for convenience in writing sample numbers, etc., or paste-on labels can be used.

(x) Cover glass #1-1/2.

(xi) Scalpel (#10, curved blade).

(xii) Fine tipped forceps.

(xiii) Aluminum block for clearing filter.

(xiv) Automatic adjustable pipette, 100- to 500-µL.

(xv) Micropipette, 5 µL.

(c) Reagents.

(i) Acetone (HPLC grade).

(ii) Triacetin (glycerol triacetate).

(iii) Lacquer or nail polish.

(d) Standard Preparation. A way to prepare standard asbestos samples of known concentration has not been developed. It is possible to prepare replicate samples of nearly equal concentration. This has been performed through the PAT program. These asbestos samples are distributed by the AIHA to participating laboratories. Since only about one-fourth of a 25-mm sample membrane is required for an asbestos count, any PAT sample can serve as a "standard" for replicate counting.

(e) Sample Mounting.

Note: See Safety Precautions in (6)(a) before proceeding. The objective is to produce samples with a smooth (non-grainy) background in a medium with a refractive index of approximately 1.46. The technique below collapses the filter for easier focusing and produces permanent mounts which are useful for quality control and interlaboratory comparison. An aluminum block or similar device is required for sample preparation.

(i) Heat the aluminum block to about 70°C. The hot block should not be used on any surface that can be damaged by either the heat or from exposure to acetone.

(ii) Ensure that the glass slides and cover glasses are free of dust and fibers.

(iii) Remove the top plug to prevent a vacuum when the cassette is opened. Clean the outside of the cassette if necessary. Cut the seal and/or tape on the cassette with a razor blade.

Very carefully separate the base from the extension cowl, leaving the filter and backup pad in the base.

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(iv) With a rocking motion cut a triangular wedge from the filter using the scalpel. This wedge should be one-sixth to one-fourth of the filter. Grasp the filter wedge with the forceps on the perimeter of the filter which was clamped between the cassette pieces. **DO NOT TOUCH** the filter with your finger. Place the filter on the glass slide sample side up. Static electricity will usually keep the filter on the slide until it is cleared.

(v) Place the tip of the micropipette containing about 200 µL acetone into the aluminum block. Insert the glass slide into the receiving slot in the aluminum block. Inject the acetone into the block with slow, steady pressure on the plunger while holding the pipette firmly in place. Wait 3 to 5 seconds for the filter to clear, then remove the pipette and slide from the aluminum block.

(vi) Immediately (less than 30 seconds) place 2.5 to 3.5 µL of triacetin on the filter (Note: Waiting longer than 30 seconds will result in increased index of refraction and decreased contrast between the fibers and the preparation. This may also lead to separation of the cover slip from the slide).

(vii) Lower a cover slip gently onto the filter at a slight angle to reduce the possibility of forming air bubbles. If more than 30 seconds have elapsed between acetone exposure and triacetin application, glue the edges of the cover slip to the slide with lacquer or nail polish.

(viii) If clearing is slow, warm the slide for 15 min on a hot plate having a surface temperature of about 50°C to hasten clearing. The top of the hot block can be used if the slide is not heated too long.

(ix) Counting may proceed immediately after clearing and mounting are completed.

(f) Sample Analysis. Completely align the microscope according to the manufacturer's instructions. Then, align the microscope using the following general alignment routine at the beginning of every counting session and more often if necessary.

(i) Alignment.

(A) Clean all optical surfaces. Even a small amount of dirt can significantly degrade the image.

(B) Rough focus the objective on a sample.

(C) Close down the field iris so that it is visible in the field of view. Focus the image of the iris with the condenser focus. Center the image of the iris in the field of view.

(D) Install the phase telescope and focus on the phase rings. Critically center the rings. Misalignment of the rings results in astigmatism which will degrade the image.

(E) Place the phase-shift test slide on the microscope stage and focus on the lines. The analyst must see line set 3 and should see at least parts of 4 and 5 but, not see line set 6 or 6. A microscope/microscopist combination which does not pass this test may not be used.

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(ii) Counting Fibers.

(A) Place the prepared sample slide on the mechanical stage of the microscope. Position the center of the wedge under the objective lens and focus upon the sample.

(B) Start counting from one end of the wedge and progress along a radial line to the other end (count in either direction from perimeter to wedge tip). Select fields randomly, without looking into the eyepieces, by slightly advancing the slide in one direction with the mechanical stage control.

(C) Continually scan over a range of focal planes (generally the upper 10 to 15 µm of the filter surface) with the fine focus control during each field count. Spend at least 5 to 15 seconds per field.

(D) Most samples will contain asbestos fibers with fiber diameters less than 1µ. Look carefully for faint fiber images. The small diameter fibers will be very hard to see. However, they are an important contribution to the total count.

(E) Count only fibers equal to or longer than 5µ. Measure the length of curved fibers along the curve.

(F) Count fibers which have a length to width ratio of 3:1 or greater.

(G) Count all the fibers in at least 20 fields. Continue counting until either 100 fibers are counted or 100 fields have been viewed; whichever occurs first. Count all the fibers in the final field.

(H) Fibers lying entirely within the boundary of the Walton-Beckett graticule field receive a count of 1. Fibers crossing the boundary once, having one end within the circle receive a count of 1/2. Do not count any fiber that crosses the graticule boundary more than once. Reject and do not count any other fibers even though they may be visible outside the graticule area. If a fiber touches the circle, it is considered to cross the line.

(I) Count bundles of fibers as one fiber unless individual fibers can be clearly identified and each individual fiber is clearly not connected to another counted fiber.

(J) Record the number of fibers in each field in a consistent way such that filter non-uniformity can be assessed.

(K) Regularly check phase ring alignment.

(L) When an agglomerate (mass of material) covers more than 25% of the field of view, reject the field and select another. Do not include it in the number of fields counted.

(M) Perform a “blind recount” of 1 in every 10 filter wedges (slides). Re-label the slides using a person other than the original counter.

(g) Fiber Identification. As previously mentioned in (1)(c), PCM does not provide positive confirmation of asbestos fibers. Alternate differential counting techniques should be used if discrimination is desirable. Differential counting may include primary discrimination based on

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morphology, polarized light analysis of fibers, or modification of PCM data by Scanning Electron or Transmission Electron Microscopy. A great deal of experience is required to routinely and correctly perform differential counting. It is discouraged unless it is legally necessary. Then, only if a fiber is obviously not asbestos should it be excluded from the count. Further discussion of this technique can be found in reference 8(j). If there is a question whether a fiber is asbestos or not, follow the rule: **"WHEN IN DOUBT, COUNT."**

(h) Analytical Recommendations--Quality Control System.

(i) All individuals performing asbestos analysis must have taken the NIOSH course for sampling and evaluating airborne asbestos or an equivalent course.

(ii) Each laboratory engaged in asbestos counting must set up a slide trading arrangement with at least two other laboratories in order to compare performance and eliminate inbreeding of error. The slide exchange occurs at least semiannually. The round robin results must be posted where all analysts can view individual analyst's results.

(iii) Each laboratory engaged in asbestos counting must participate in the Proficiency Analytical Testing Program, the Asbestos Analyst Registry or equivalent.

(iv) Each analyst must select and count prepared slides from a "slide bank". These are quality assurance counts. The slide bank must be prepared using uniformly distributed samples taken from the workload. Fiber densities should cover the entire range routinely analyzed by the laboratory. These slides are counted blind by all counters to establish an original standard deviation. This historical distribution is compared with the quality assurance counts. A counter must have 95% of all quality control samples counted within three standard deviations of the historical mean. This count is then integrated into a new historical mean and standard deviation for the slide. The analyses done by the counters to establish the slide bank may be used for an interim quality control program if the data are treated in a proper statistical fashion.

7. **Calculations.**

(a) Calculate the estimated airborne asbestos fiber concentration on the filter sample using the following formula:

$$AC = \frac{\left[\left(\frac{FB}{FL}\right) - \left(\frac{BFB}{BFL}\right)\right] X\ ECA}{1000\ X\ FR\ X\ T\ X\ MFA}$$

Where:

AC	=	Airborne fiber concentration
FB	=	Total number of fibers greater than 5 µm counted
FL	=	Total number of fields counted on the filter
BFB	=	Total number of fibers greater than 5µm counted in the blank
BFL	=	Total number of fields counted on the blank
ECA	=	Effective collecting area of filter (385 mm^2 nominal for a 25-mm filter.)
FR	=	Pump flow rate (L/min)
MFA	=	Microscope count field area (mm^2). This is 0.00785 mm^2 for a Walton-Beckett Graticule.
T	=	Sample collection time (min)

1,000	=	Conversion of L to cc

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Note: The collection area of a filter is seldom equal to 385 mm^2. It is appropriate for laboratories to routinely monitor the exact diameter using an inside micrometer. The collection area is calculated according to the formula:

$$\textbf{Area} = \pi(d/2)^2$$

(b) Short-cut Calculation

Since a given analyst always has the same interpupillary distance, the number of fields per filter for a particular analyst will remain constant for a given size filter. The field size for that analyst is constant (i.e. the analyst is using an assigned microscope and is not changing the reticle). For example, if the exposed area of the filter is always 385 mm^2 and the size of the field is always 0.00785 mm^2, the number of fields per filter will always be 49,000. In addition it is necessary to convert liters of air to cc. These three constants can then be combined such that ECA/(1,000 X MFA) = 49. The previous equation simplifies to:

$$AC = \frac{\left(\frac{FB}{FL}\right) - \left(\frac{BFB}{BFL}\right) X\, 49}{FR\ X\ T}$$

(c) Recount Calculations. As mentioned in step 13 of 6 (f)(ii), a "blind recount" of 10% of the slides is performed. In all cases, differences will be observed between the first and second counts of the same filter wedge. Most of these differences will be due to chance alone, that is, due to the random variability (precision) of the count method. Statistical recount criteria enables one to decide whether observed differences can be explained due to chance alone or are probably due to systematic differences between analysts, microscopes, or other biasing factors. The following recount criterion is for a pair of counts that estimate AC in fibers/cc. The criterion is given at the type-I error level. That is, there is 5% maximum risk that we will reject a pair of counts for the reason that one might be biased, when the large observed difference is really due to chance. Reject a pair of counts if:

$$\left|\sqrt{AC_2} - \sqrt{AC_1}\right| > 2.78\ X \left(\sqrt{AC_{avg}}\right) X\ CV_{FB}$$

Where:

$\mathbf{AC_1}$	=	lower estimated airborne fiber concentration
$\mathbf{AC_2}$	=	higher estimated airborne fiber concentration
$\mathbf{AC_{avg}}$	=	average of the two concentration estimates
$\mathbf{CV_{FB}}$	=	CV for the average of the two concentration estimates

If a pair of counts are rejected by this criterion then, recount the rest of the filters in the submitted set. Apply the test and reject any other pairs failing the test. Rejection shall include a memo to the industrial hygienist stating that the sample failed a statistical test for homogeneity and the true air concentration may be significantly different than the reported value.

(d) Reporting Results. Report results to the industrial hygienist as fibers/cc. Use two significant figures. If multiple analyses are performed on a sample, an average of the results is to be reported unless any of the results can be rejected for cause.

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8. **References.**

(a) Dreesen, W.C., et al, U.S. Public Health Service: A Study of Asbestosis in the Asbestos Textile Industry, (Public Health Bulletin No. 241), US Treasury Dept., Washington, DC, 1938.

(b) Asbestos Research Council: The Measurement of Airborne Asbestos Dust by the Membrane Filter Method (Technical Note), Asbestos Research Council, Rockdale, Lancashire, Great Britain, 1969.

(c) Bayer, S.G., Zumwalde, R.D., Brown, T.A., Equipment and Procedure for Mounting Millipore Filters and Counting Asbestos Fibers by Phase Contrast Microscopy, Bureau of Occupational Health, U.S. Dept. of Health, Education and Welfare, Cincinnati,OH,1969.

(d) NIOSH Manual of Analytical Methods, 2nd ed., Vol. 1 (DHEW/NIOSH Pub. No. 77-157-A). National Institute for Occupational Safety and Health, Cincinnati, OH, 1977.pp.239-1-239-21.

(e) Asbestos, Code of Federal Regulations 29 CFR 1910.1001. 1971.

(f) Occupational Exposure to Asbestos, Tremolite, Anthophyllite, and Actinolite. Final Rule, Federal Register 51: 119 (20 June 1986). pp.22612-22790.

(g) Asbestos, Tremolite, Anthophyllite, and Actinolite, Code of Federal Regulations 1910.1001. 1988. pp 711-752.

(h) Criteria for a Recommended Standard--Occupational Exposure to Asbestos (DHEW/NIOSH Pub. No. HSM 72-10267), National Institute for Occupational Safety and Health NIOSH, Cincinnati, OH, 1972. pp. III-1-III-24.

(i) Leidel, N.A., Bayer, S.G., Zumwalde, R.D., Busch, K.A., USPHS/NIOSH Membrane Filter Method for Evaluating Airborne Asbestos Fibers (DHEW/NIOSH Pub. No. 79-127). National Institute for Occupational Safety and Health, Cincinnati, OH, 1979.

(j) Dixon, W.C., Applications of Optical Microscopy in Analysis of Asbestos and Quartz, Analytical Techniques in Occupational Health Chemistry, edited by D.D. Dollberg and A.W. Verstuyft. Wash. D.C.: American Chemical Society, (ACS Symposium Series 120) 1980. pp. 13-41.

9. **Quality Control.** The OSHA asbestos regulations require each laboratory to establish a quality control program. The following is presented as an example of how the OSHA-SLTC constructed its internal CV curve as part of meeting this requirement. Data for the CV curve shown below is from 395 samples collected during OSHA compliance inspections and analyzed from October 1980 through April 1986. Each sample was counted by 2 to 5 different counters independently of one another. The standard deviation and the CV statistic was calculated for each sample. This data was then plotted on a graph of CV vs. fibers/mm^2. A least squares regression was performed using the following equation:

$$\mathbf{CV = antilog_{10}[A(log_{10}(x))2+B(log_{10}(x))+C]}$$

Where:

x	=	the number of fibers/mm^2
		Application of least squares gave:
A	=	0.182205
B	=	-0.973343
C	=	0.327499

Using these values, the equation becomes:

$$CV = \text{antilog}_{10}[0.182205(\log_{10}(x))^2 - 0.973343(\log_{10}(x)) + 0.327499].$$

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10. **Sampling Pump Flow Rate Corrections**. This correction is used if a difference greater than 5% in ambient temperature and/or pressure is noted between calibration and sampling sites and the pump does not compensate for the differences.

$$Q_{act} = Q_{cal} \times \sqrt{\left(\frac{P_{cal}}{P_{act}}\right) \times \left(\frac{T_{act}}{T_{cal}}\right)}$$

Where:

Qact	=	actual flow rate
Qcal	=	calibrated flow rate (if a rotameter was used, the rotameter value)
Pcal	=	uncorrected air pressure at calibration
Pact	=	uncorrected air pressure at sampling site
Tact	=	temperature at sampling site (K)
Tcal	=	temperature at calibration (K)

11. **Walton-Beckett Graticule**

When ordering the Graticule for asbestos counting, specify the exact disc diameter needed to fit the ocular of the microscope and the diameter (mm) of the circular counting area. Instructions for measuring the dimensions necessary are listed:

(a) Insert any available graticule into the focusing eyepiece and focus so that the graticule lines are sharp and clear.

(b) Align the microscope.

(c) Place a stage micrometer on the microscope object stage and focus the microscope on the graduated lines.

(d) Measure the magnified grid length, PL (µm), using the stage micrometer.

(e) Remove the graticule from the microscope and measure its actual grid length, AL (mm). This can be accomplished by using a mechanical stage fitted with verniers, or a jeweler's loupe with a direct reading scale.

(f) Let D = 100 µm. Calculate the circle diameter, d_C (mm), for the Walton-Beckett graticule and specify the diameter when making a purchase:

$$D_c = \frac{AL \times D}{PL}$$

Example: If PL = 108 µm, AL = 2.93 mm and D = 100 µm, then,
d_c = (2.93 x 100)/108 = 2.71 mm

(g) Each eyepiece-objective-reticle combination on the microscope must be calibrated. Should any of the three be changed (by zoom adjustment, disassembly, replacement, etc.), the combination must be recalibrated. Calibration may change if interpupillary distance is changed. Measure the field diameter, D (acceptable range: 100 ±2 µm) with a stage micrometer upon receipt of the graticule from the manufacturer. Determine the field area (mm2).

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Field Area = $\pi(D/2)2$

If D = 100 μm = 0.1 mm, then

Field Area = $+(0.1 \text{ mm}/2)^2 = 0.00785 \text{ mm}^2$

The Graticule is available from: Graticules Ltd., Morley Road, Tonbridge TN9 IRN, Kent, England (Telephone 011-44-732-359061). Also available from PTR Optics Ltd., 145 Newton Street, Waltham, MA 02154 [telephone (617) 891-6000] or McCrone Accessories and Components, 2506 S. Michigan Ave., Chicago, IL 60616 [phone (312) 842-7100]. The graticule is custom made for each microscope.

BILLING CODE 4510-26-P

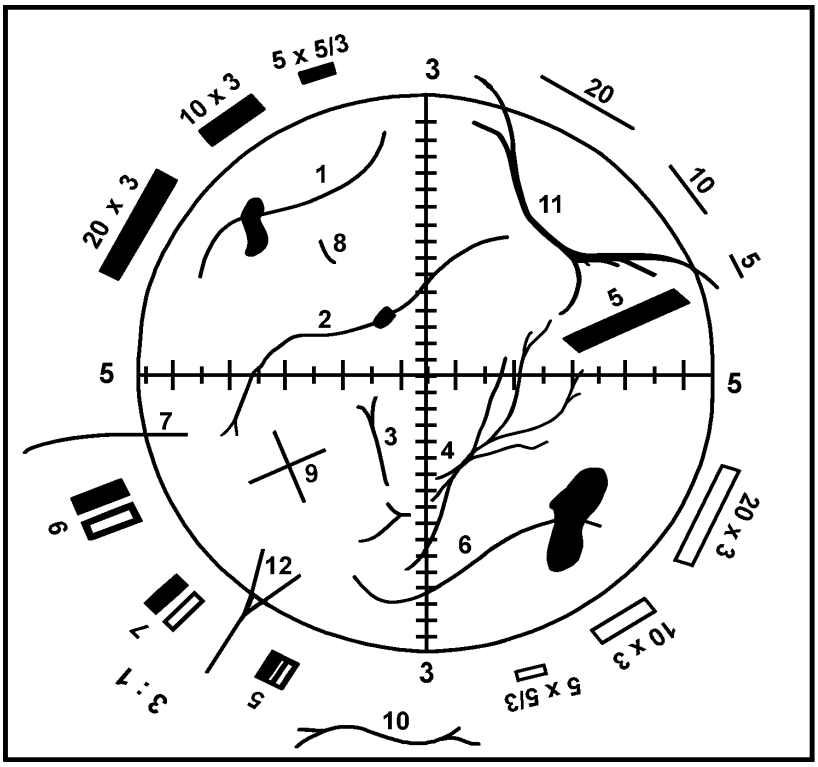

Figure 1: Walton-Beckett Graticule with some explanatory fibers.

Counts for the Fibers in the Figure

Structure No.	Count	Explanation
1 to 6	1	Single fibers all contained within the circle.
7	1/2	Fiber crosses circle once.
8	0	Fiber too short.
9	2	Two crossing fibers.
10	0	Fiber outside graticule.
11	0	Fiber crosses graticule twice.
12	1/2	Although split, fiber only crosses once.

[Statutory Authority: RCW 49.17.040, .050, RCW 49.26.040 and RCW 49.26.130. 99-17-026 (Order 98-35), § 296-62-07737, filed 08/10/99, effective 11/10/99. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07737, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-07737, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07737, filed 4/27/87.]

WAC 296-62-07741 Appendix D--Medical questionnaires--Mandatory. This mandatory appendix contains the medical questionnaires that must be administered to all employees who are exposed to asbestos, tremolite, anthophyllite, and actinolite, or a combination of these minerals above the permissible exposure limit (0.1 f/cc), and who will therefore be included in their employer's medical surveillance program. Part 1 of the appendix contains the initial medical questionnaire, which must be obtained for all new hires who will be covered by the medical surveillance requirements. Part 2 includes the abbreviated periodical medical questionnaire, which appendix contains the medical questionnaires that must be administered to all employees who are must be administered to all employees who are provided periodic medical examinations under the medical surveillance provisions of the standard.

PART 1
INITIAL MEDICAL QUESTIONNAIRE

1. NAME _____
2. SOCIAL SECURITY # … … … … … … … … … …
   1 2 3 4 5 6 7 8 9
3. CLOCK NUMBER … … … … … …
   10 11 12 13 14 15
4. PRESENT OCCUPATION _____
5. PLANT _____
6. ADDRESS _____
7. _____
   (Zip Code)
8. TELEPHONE NUMBER _____
9. INTERVIEWER _____
10. DATE _____ … … … … … …
    16 17 18 19 20 21
11. Date of birth …….. … … … … … …
    Month Day Year 22 23 24 25 26 27
12. Place of birth _____
13. Sex 1. Male _____
    2. Female _____
14. What is your marital status? 1. Single _____ 4. Separated/
    2. Married _____ Divorced _____
    3. Widowed _____
15. Race 1. White _____ 4. Hispanic _____
    2. Black _____ 5. Indian _____
    3. Asian _____ 6. Other_____
16. What is the highest grade completed in school? _____
    (For example 12 years is completion of high school)

OCCUPATIONAL HISTORY

17A. Have you ever worked full time (30 hours per week or more) for 6 months or more? 1. Yes_____ 2. No _____

If yes to 17A:

B. Have you ever worked for a year or more in any dusty job? 1. Yes _____ 2. No _____ 3. Does not apply _____
Specify job/industry Total years worked _____
Was dust exposure: 1. Mild _____ 2. Moderate _____3. Severe _____

C Have you ever been exposed to gas or chemical fumes in your work? 1. Yes _____ 2. No _____
Specify job/industry Total years worked _____
Was exposure: 1. Mild _____ 2. Moderate _____ 3. Severe _____

D What has been your usual occupation or job--the one you have worked at the longest?
1. Job occupation

2. Number of years employed in this occupation

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3. Position/job title
4. Business, field or industry

(Record on lines the years in which you have worked in any of these industries, e.g., 1960-1969.)

Have you ever worked:

		YES	NO
E.	In a mine?	r	r
F.	In a quarry?	r	r
G	In a foundry?	r	r
H.	In a pottery?	r	r
I.	In a cotton, flax or hemp mill?	r	r
J.	With asbestos?	r	r

18. **PAST MEDICAL HISTORY**

		YES	NO
A.	Do you consider yourself to be in good health?	r	r
	If "no" state reason		
B.	Have you any defect in vision?	r	r
	If "yes" state nature of defect _____		
C.	Have you any hearing defect?	r	r
	If "yes" state nature of defect _____		
D.	Are you suffering from or have you ever suffered from:		
	a. Epilepsy (or fits, seizures, convulsions)?	r	r
	b. Rheumatic fever?	r	r
	c. Kidney disease?	r	r
	d. Bladder disease?	r	r
	e. Diabetes?	r	r
	f. Jaundice	r	r

19. **CHEST COLDS AND CHEST ILLNESSES**

19A. If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time.) 1. Yes _____ 2. No _____ 3. Don't get colds _____

20A. During the past 3 years, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? 1. Yes _____ 2. No _____

If yes to 20A:

B Did you produce phlegm with any of these chest illnesses? 1. Yes _____ 2. No _____ 3. Does not apply _____

C. In the last 3 years, how many such illnesses with (increased) phlegm did you have which lasted a week or more? Number of illnesses _____ No such illnesses _____

21. Did you have any lung trouble before the age of 16? 1. Yes _____ 2. No_____

22. Have you ever had any of the following?

1A Attacks of bronchitis? 1. Yes _____ 2. No _____

If yes to 1A:

B. Was it confirmed by a doctor? 1. Yes _____ 2. No _____ 3. Does not apply _____

C. At what age was your first attack? Age in years _____ Does not apply _____

2A. Pneumonia? (include broncho-pneumonia) 1. Yes ____ 2. No _____

If yes to 2A:

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	B.	Was it confirmed by a doctor?	1. Yes _____ 2. No_____ 3. Does not apply _____
	C.	At what age did you first have it?	Age in years _____ Does not apply _____
	3A.	Hay fever?	1. Yes _____ 2. No _____
		If yes to 3A:	
	B.	Was it confirmed by a doctor?	1. Yes _____ 2. No _____ 3. Does not apply _____
	C.	At what age did it start?	Age in years _____ Does not apply _____
23A.		Have you ever had chronic bronchitis?	1. Yes _____ 2. No _____
		If yes to 23A:	
	B.	Do you still have it?	1. Yes _____ 2. No _____ 3. Does not apply _____
	C.	Was it confirmed by a doctor?	1. Yes _____ 2. No _____ 3. Does not apply _____
	D	At what age did it start?	Age in years _____ Does not apply _____
24A.		Have you ever had emphysema?	1. Yes _____ 2. No _____
		If yes to 24A:	
	B.	Do you still have it?	1. Yes _____ 2. No _____ 3. Does not apply _____
	C.	Was it confirmed by a doctor?	1. Yes _____ 2. No _____ 3. Does not apply _____
	D.	At what age did it start?	Age in years _____ Does not apply _____
25A.		Have you ever had asthma?	1. Yes _____ 2. No _____
		If yes to 25A:	
	B.	Do you still have it?	1. Yes _____ 2. No _____ 3. Does not apply _____
	C.	Was it confirmed by a doctor?	1. Yes _____ 2. No _____ 3. Does not apply _____
	D.	At what age did it start?	Age in years _____ Does not apply _____
	E.	If you no longer have it, at what age did it stop?	Age stopped _____ Does not apply _____
26.		Have you ever had:	
	A.	Any other chest illness?	1. Yes _____ 2. No _____
		If yes, please specify _____	
	B.	Any chest operations?	1. Yes _____ 2. No _____
		If yes, please specify _____	
	C.	Any chest injuries?	1. Yes _____ 2. No _____
		If yes, please specify _____	
27A.		Has a doctor ever told you that you had heart trouble?	1. Yes _____ 2. No _____
		If yes to 27A:	
	B.	Have you ever had treatment for heart trouble in the past 10 years?	1. Yes _____ 2. No _____ 3. Does not apply _____
28A.		Has a doctor ever told you that you had high blood pressure?	1. Yes _____ 2. No _____
		If yes to 28A:	
	B.	Have you had any treatment for high blood pressure (hypertension) in the past 10 years?	1. Yes _____ 2. No _____ 3. Does not apply _____

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29. When did you last have your chest x-rayed? (Year) … … … … 25 26 27 28

30. Where did you last have your chest x-rayed (if known)? What was the outcome? _____

FAMILY HISTORY

31. Were either of your natural parents ever told by a doctor that they had a chronic lung condition such as:

		FATHER			MOTHER		
		1. Yes	2. No.	3. Don't Know	1. Yes	2. No	3. Don't Know
A.	Chronic Bronchitis?	_____	_____	_____	_____	_____	_____
B.	Emphysema?	_____	_____	_____	_____	_____	_____
C.	Asthma?	_____	_____	_____	_____	_____	_____
D.	Lung cancer?	_____	_____	_____	_____	_____	_____
E.	Other chest conditions?	_____	_____	_____	_____	_____	_____
F.	Is parent currently alive?	_____	_____	_____	_____	_____	_____
G.	Please specify	_____ Age if living _____ Age at death _____ Don't know			Age if living _____ Age at death _____ Don't know _____		

H. Please specify cause of death_____

COUGH

32A. Do you usually have a cough? (Count a cough with first smoke or on first going out of doors. Exclude clearing of throat.) (If no, skip to question 32C.) 1. Yes _____ 2. No _____

B. Do you usually cough as much as 4 to 6 times a day 4 or more days out of the week? 1. Yes _____ 2. No _____

C. Do you usually cough at all on getting up or first thing in the morning? 1. Yes _____ 2. No _____

D. Do you usually cough at all during the rest of the day or at night? 1. Yes _____2. No _____

IF YES TO ANY OF ABOVE (32A, B, C, OR D), ANSWER THE FOLLOWING. IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO NEXT PAGE

E. Do you usually cough like this on most days for 3 consecutive months or more during the year? 1. Yes _____ 2. No _____ 3. Does not apply _____

F. For how many years have you had the cough? Number of years _____ Does not apply _____

33A. Do you usually bring up phlegm from your chest? (Count phlegm with the first smoke or on first going out of doors. Exclude phlegm from the nose. Count swallowed phlegm.) (If no, skip to 33C.) 1. Yes _____ 2. No _____

B. Do you usually bring up phlegm like this as much as twice a day 4 or more days out of the week? 1. Yes _____ 2. No _____

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C. Do you usually bring up phlegm at all on getting up or first thing in the morning? 1. Yes _____ 2. No _____

D. Do you usually bring up phlegm at all during the rest of the day or at night? 1. Yes _____ 2. No _____

IF YES TO ANY OF THE ABOVE (33A, B, C, OR D), ANSWER THE FOLLOWING: IF NO TO ALL, CHECK DOES NOT APPLY AND SKIP TO 34A.

E. Do you bring up phlegm like this on most days for 3 consecutive months or more during the year? 1. Yes _____ 2. No _____ 3. Does not apply _____

F. For how many years have you had trouble with phlegm? episodes of cough and phlegm Number of years_____ Does not apply _____

34A. Have you had periods or episodes of increased*) cough and phlegm lasting for 3 weeks or more each year? 1. Yes _____ 2. No _____

*(For persons who usually have cough and/or phlegm.)

If yes to 34A:

B. For how long have you had at least 1 such episode per year? Number of years _____ Does not apply _____

WHEEZING

35A. Does your chest ever sound wheezy or whistling:

1. When you have a cold? 1. Yes _____ 2. No _____
2. Occasionally apart from colds? 1. Yes _____ 2. No _____
3. Most days or nights? 1. Yes _____ 2. No _____

If yes to 1, 2, or 3 in 35A:

B. For how many years has this been present? Number of years _____ Does not apply _____

36A. Have you ever had an attack of wheezing that has made you feel short of breath? 1. Yes _____ 2. No _____

If yes to 36A:

B. How old were you when you had your first such attack? Age in years _____ Does not apply _____

C. Have you had 2 or more such episodes? 1. Yes _____ 2. No _____ 3. Does not apply _____

D. Have you ever required medicine or treatment for the(se) attack(s)? 1. Yes _____ 2. No _____ 3. Does not apply _____

BREATHLESSNESS

37. If disabled from walking by any condition other than heart or lung disease, please describe and proceed to question 39A.

Nature of condition(s)

38A. Are you troubled by shortness of breath when hurrying on the level or walking up a slight hill? 1. Yes _____ 2. No _____

If yes to 38A:

B. Do you have to walk slower than people of your age on the level because of breathlessness? 1. Yes _____ 2. No _____ 3. Does not apply _____

C. Do you ever have to stop for breath when 1. Yes _____2. No _____

walking at your own pace on the level? 3. Does not apply _____

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D.	Do you ever have to stop for breath after walking about 100 yards (or after a few minutes) on the level?	1. Yes _____2. No _____ 3. Does not apply _____
E.	Are you too breathless to leave the house or breathless on dressing or climbing one flight of stairs?	1. Yes _____ 2. No _____ 3. Does not apply _____

TOBACCO SMOKING

39A.	Have you ever smoked cigarettes? (No means less than 20 packs of cigarettes or 12 oz. of tobacco in a lifetime or less than 1 cigarette a day for 1 year.)	1. Yes _____ 2. No _____
	If yes to 39A:	
B.	Do you now smoke cigarettes (as of one month ago)?	1. Yes _____2. No _____ 3. Does not apply _____
C.	How old were you when you first started regular cigarette smoking?	Age in years _____ Does not apply _____
D.	If you have stopped smoking cigarettes completely, how old were you when you stopped?	Aged stopped _____ Check if still smoking _____ Does not apply _____
E.	How many cigarettes do you smoke per day now?	Cigarettes per day _____ Does not apply _____
F.	On the average of the entire time you smoked, how many cigarettes did you smoke per day?	Cigarettes per day _____ Does not apply _____
G.	Do you or did you inhale the cigarette smoke?	1. Does not apply _____ 2. Not at all _____ 3. Slightly _____ 4. Moderately _____ 5. Deeply _____
40A.	Have you ever smoked a pipe regularly? (Yes means more than 12 ounces of tobacco in a lifetime.)	1. Yes _____ 2. No _____
	If yes to 40A:	

FOR PERSONS WHO HAVE EVER SMOKED A PIPE

B.1.	How old were you when you started to smoke a pipe regularly?	Age _____
2.	If you have stopped smoking a pipe completely, how old were you when you stopped?	Age stopped _____ Check if still smoking pipe _____ Does not apply _____
C.	On the average over the entire time you smoked a pipe, how much pipe tobacco did you smoke per week?	_____ oz. per week (a standard pouch of tobacco contains 1-1/2 ounces) _____ Does not apply
	How much pipe tobacco are you smoking now?	oz. per week _____ Not currently smoking a pipe _____
E.	Do you or did you inhale the pipe smoke?	1. Never smoked _____ 2. Not at all _____ 3. Slightly _____

4. Moderately _____
5. Deeply _____

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41A. Have you ever smoked cigars regularly? (Yes means more than 1 cigar a week for a year.) 1. Yes _____ 2. No _____

If yes to 41A:

FOR PERSONS WHO HAVE EVER SMOKED CIGARS

B.1.	How old were you when you started smoking cigars regularly?	Age _____
2.	If you have stopped smoking cigars completely, how old were you when you stopped?	Age stopped _____ Check if still smoking cigars _____ Does not apply _____
C.	On the average over the entire time you smoked cigars, how many cigars did you smoke per week?	Cigars per week _____ Does not apply _____
D.	How many cigars are you smoking per week now?	Cigars per week _____ Check if not smoking cigars currently _____
E.	Do you or did you inhale the cigar smoke?	1. Never smoked _____ 2. Not at all _____ 3. Slightly _____ 4. Moderately _____ 5. Deeply _____

Signature _____ Date _____

PART 2
PERIODIC MEDICAL QUESTIONNAIRE

1. NAME _____
2. SOCIAL SECURITY # … … … … … … … … … …
   1 2 3 4 5 6 7 8 9
3. CLOCK NUMBER … … … … … …
   10 11 12 13 14 15
4. PRESENT OCCUPATION _____
5. PLANT _____
6. ADDRESS _____
7. _____
   (Zip Code)
8. TELEPHONE NUMBER _____
9. INTERVIEWER _____
10. DATE _____ … … … … … …
    16 17 18 19 20 21
11. What is your marital status? 1. Single _____ 2. Married _____ 3. Widowed _____ 4. Separated/ Divorced _____

12. **OCCUPATIONAL HISTORY**

12A. Have you ever worked full time (30 hours per week or more) for 6 months or more? 1. Yes_____ 2. No _____

If yes to 12A:

12 B. In the past, did you work in a dusty job? 1. Yes _____ 2. No _____ 3. Does not apply _____

12 C	Was dust exposure:	1. Mild _____ 2. Moderate _____3. Severe _____

WAC 296-62-07741 (Cont.)

12 D	In the past, were you exposed to gas or chemical fumes in your work?	1. Yes_____ 2. No _____
12 E	Was exposure	1. Mild _____ 2. Moderate _____3. Severe _____
12 F.	In the past year, what was your:	1. Job occupation? _____ 2. Position/job title? _____

13. **RECENT MEDICAL HISTORY**

13A.	Do you consider yourself to be in good health?	Yes _____ No _____ If no, state reason _____
13B.	In the past year, have you developed:	Yes _____ No _____ Epilepsy? _____ Rheumatic fever? _____ Kidney disease? _____ Bladder disease? _____ Diabetes? _____ Jaundice? _____ Cancer? _____

14. **CHEST COLDS AND CHEST ILLNESS**

14A.	If you get a cold, does it usually go to your chest? (Usually means more than 1/2 the time.)	1. Yes _____ 2. No _____ 3. Don't get colds _____
15A.	During the past year, have you had any chest illnesses that have kept you off work, indoors at home, or in bed? If yes to 15a:	1. Yes _____2. No _____ 3. Does not apply _____
15B.	Did you produce phlegm with any of these chest illnesses?	1. Yes _____ 2. No _____ 3. Does not apply _____
15C.	In the past year, how many such illnesses with (increased) phlegm did you have which lasted a week or more?	Number of illnesses _____ No such illnesses _____

16. **RESPIRATORY SYSTEM**

In the past year have you had:

	Yes or No		Further Comment on Positive Answers
Asthma	_____	Bronchitis	_____
Hay fever	_____	Other allergies	_____

	Yes or No		Further Comment on Positive Answers
Pneumonia	_____	Tuberculosis	_____
Chest surgery	_____	Other lung	_____
Problems	_____	Heart disease	_____

Do you have:

	Yes or No		Further Comment on Positive Answers
Frequent colds	_____	Chronic cough	_____
Shortness of breath when walking or climbing one flight of stairs	_____		

WAC 296-62-07741 (Cont.)

Do you:
Wheeze _____ Cough up phlegm _____
Smoke cigarettes _____ Packs per day _____ How many years _____

Date _____ Signature _____

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07741, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-07741, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07741, filed 4/27/87.]

WAC 296-62-07743 Appendix E--Interpretation and classification of chest roentgenograms--Mandatory.

(1) Chest roentgenograms shall be interpreted and classified in accordance with a professionally accepted classification system and recorded on an interpretation form following the format of the CDC/NIOSH (M) 2.8 form. As a minimum, the content within the bold lines of this form (items one through four) shall be included. This form is not to be submitted to NIOSH.

(2) Roentgenograms shall be interpreted and classified only by a B-reader, a board eligible/certified radiologist, or an experienced physician with known expertise in pneumoconioses.

(3) All interpreters, whenever interpreting chest roentgenograms made under this section, shall have immediately available for reference a complete set of the ILO-U/C International Classification of Radiographs for Pneumoconioses, 1980.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-07743, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07743, filed 4/27/87.]

WAC 296-62-07745 Appendix F--Work practices and engineering controls for automotive brake and clutch inspection, disassembly, repair and assembly--Mandatory. This mandatory appendix specifies engineering controls and work practices that must be implemented by the employer during automotive brake and clutch inspection, disassembly, repair, and assembly operations. Proper use of these engineering controls and work practices will reduce employees' asbestos exposure below the permissible exposure level during clutch and brake inspection, disassembly, repair, and assembly operations. The employer shall institute engineering controls and work practices using either the method set forth in (1) or (2) of this appendix, or any other method which the employer can demonstrate to be equivalent in terms of reducing employee exposure to asbestos as defined and which meets the requirements described in (3) of this appendix, for those facilities in which no more than 5 pairs of brakes or 5 clutches are inspected, disassembled, reassembled and/or repaired per week, the method set forth in (4) of this appendix may be used:

(1) **Negative pressure enclosure/HEPA vacuum system method.**

(a) The brake and clutch inspection, disassembly, repair, and assembly operations shall be enclosed to cover and contain the clutch or brake assembly and to prevent the release of asbestos fibers into the worker's breathing zone.

(b) The enclosure shall be sealed tightly and thoroughly inspected for leaks before work begins on brake and clutch inspection, disassembly, repair and assembly.

(c) The enclosure shall be such that the worker can clearly see the operation and shall provide impermeable sleeves through which the worker can handle the brake and clutch inspection, disassembly, repair and assembly. The integrity of the sleeves and ports shall be examined before work begins.

WAC 296-62-07745 (Cont.)

(d) A HEPA-filtered vacuum shall be employed to maintain the enclosure under negative pressure throughout the operation. Compressed-air may be used to remove asbestos fibers or particles from the enclosure.

(e) The HEPA vacuum shall be used first to loosen the asbestos containing residue from the brake and clutch parts and then to evacuate the loosened asbestos containing material from the enclosure and capture the material in the vacuum filter.

(f) The vacuum's filter, when full, shall be first wetted with a fine mist of water, then removed and placed immediately in an impermeable container, labeled according to WAC 296-62-07721 (6) and disposed of according to WAC 296-62-07723.

(g) Any spills or releases of asbestos containing waste material from inside of the enclosure or vacuum hose or vacuum filter shall be immediately cleaned up and disposed of according to WAC 296-62-07723.

(2) **Low pressure/wet cleaning method.**

(a) A catch basin shall be placed under the brake assembly, positioned to avoid splashes and spills.

(b) The reservoir shall contain water containing an organic solvent or wetting agent. The flow of liquid shall be controlled such that the brake assembly is gently flooded to prevent the asbestos-containing brake dust from becoming airborne.

(c) The aqueous solution shall be allowed to flow between the brake drum and brake support before the drum is removed.

(d) After removing the brake drum, the wheel hub and back of the brake assembly shall be thoroughly wetted to suppress dust.

(e) The brake support plate, brake shoes and brake components used to attach the brake shoes shall be thoroughly washed before removing the old shoes.

(f) In systems using filters, the filters, when full, shall be first wetted with a fine mist of water, then removed and placed immediately in an impermeable container, labeled according to WAC 296-62-07721 (6) and disposed of according to WAC 296-62-07723.

(g) Any spills of asbestos-containing aqueous solution or any asbestos-containing waste material shall be cleaned up immediately and disposed of according to WAC 296-62-07723.

(h) The use of dry brushing during low pressure/wet cleaning operations is prohibited.

(3) Equivalent methods. An equivalent method is one which has sufficient written detail so that it can be reproduced and has been demonstrated that the exposures resulting from the equivalent method are equal to or less than the exposure which would result from the use of the method described in subsection (1) of this appendix. For purposes of making this comparison, the employer shall assume that exposures resulting from the use of the method described in subsection (1) of this appendix shall not exceed 0.016 f/cc, as measured by the WISHA reference method and as averaged over at least 18 personal samples.

WAC 296-62-07745 (Cont.)

(4) **Wet method.**

(a) A spray bottle, hose nozzle, or other implement capable of delivering a fine mist of water or amended water or other delivery system capable of delivering water at low pressure, shall be used to first thoroughly wet the brake and clutch parts. Brake and clutch components shall then be wiped clean with a cloth.

(b) The cloth shall be placed in an impermeable container, labeled according to WAC 296-62-07721 (6) and then disposed of according to WAC 296-62-07723, or the cloth shall be laundered in a way to prevent the release of asbestos fibers in excess of 0.1 fiber per cubic centimeter of air.

(c) Any spills of solvent or any asbestos containing waste material shall be cleaned up immediately according to WAC 296-62-07723.

(d) The use of dry brushing during the wet method operations is prohibited.

[Statutory Authority: RCW 49.17.010, .040, .050 and RCW 49.26.130. 00-06-075 (Order 99-40), § 296-62-07745, filed 03/01/00, effective 04/10/00. Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07745, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), 296-62-07745, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07745, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07745, filed 4/27/87.]

WAC 296-62-07747 Appendix G--Substance technical information for asbestos--Nonmandatory.

(1) **Substance identification.**

(a) Substance: "Asbestos" is the name of a class of magnesium-silicate minerals that occur in fibrous form. Minerals that are included in this group are chrysotile, crocidolite, amosite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos.

(b) Asbestos is used in the manufacture of heat-resistant clothing, automotive brake and clutch linings, and a variety of building materials including floor tiles, roofing felts, ceiling tiles, asbestos-cement pipe and sheet, and fire-resistant drywall. Asbestos is also present in pipe and boiler insulation materials, and in sprayed-on materials located on beams, in crawlspaces, and between walls.

(c) The potential for a product containing asbestos, tremolite, anthophyllite, and actinolite to release breathable fibers depends on its degree of friability. Friable means that the material can be crumbled with hand pressure and is therefore likely to emit fibers. The fibrous or fluffy sprayed-on materials used for fireproofing, insulation, or sound proofing are considered to be friable, and they readily release airborne fibers if disturbed. Materials such as vinyl-asbestos floor tile or roofing felts are considered nonfriable and generally do not emit airborne fibers unless subjected to sanding or sawing operations. Asbestos-cement pipe or sheet can emit airborne fibers if the materials are cut or sawed, or if they are broken during demolition operations.

(d) Permissible exposure: Exposure to airborne asbestos fibers may not exceed 0.1 fiber per cubic centimeter of air (0.1 f/cc) averaged over the eight-hour workday (time weighted average), or 1 fiber per cubic centimeter of air (1 f/cc) during any thirty minute period, (excursion limit).

(2) **Health hazard data.**

(a) Asbestos can cause disabling respiratory disease and various types of cancers if the fibers are inhaled. Inhaling or ingesting fibers from contaminated clothing or skin can also result in these diseases. The symptoms of these diseases generally do not appear for twenty or more years after initial exposure.

WAC 296-62-07747 (Cont.)

(b) Exposure to asbestos has been shown to cause lung cancer, mesothelioma, and cancer of the stomach and colon. Mesothelioma is a rear cancer of the thin membrane lining of the chest and abdomen. Symptoms of mesothelioma include shortness of breath, pain in the walls of the chest, and/or abdominal pain.

(3) **Respirators and protective clothing.**

(a) Respirators: You are required to wear a respirator when performing tasks that result in asbestos exposure that exceeds 0.1 fiber per cubic centimeter of air (0.1 f/cc) as an eight-hour time weighted average and/or 1.0 fiber per cubic centimeter (1 f/cc) during any thirty minute period (excursion limit). These conditions can occur while your employer is in the process of installing engineering controls to reduce asbestos exposure, or where engineering controls are not feasible to reduce asbestos exposure. Air-purifying respirators equipped with a high-efficiency particulate air (HEPA) filter can be used where airborne asbestos fiber concentrations do not exceed 1 f/cc; otherwise, air-supplied, positive-pressure, full facepiece respirators must be used. Disposable respirators or dust masks are not permitted to be used for asbestos work. For effective protection, respirators must fit your face and head snugly. Your employer is required to conduct fit tests when you are first assigned a respirator and every six months thereafter. Respirators should not be loosened or removed in work situations where their use is required.

(b) Protective clothing: You are required to wear protective clothing in work areas where asbestos fiber concentrations exceed the permissible exposure limits to prevent contamination of the skin. Where protective clothing is required, your employer must provide you with clean garments. Unless you are working on a large asbestos removal or demolition project, your employer must also provide a change room and separate lockers for your street clothes and contaminated work clothes. If you are working on a large asbestos removal or demolition project, and where it is feasible to do so, your employer must provide a clean room, shower, and decontamination room contiguous to the work area. When leaving the work area, you must remove contaminated clothing before proceeding to the shower. If the shower is not adjacent to the work area, you must vacuum your clothing before proceeding to the change room and shower. To prevent inhaling fibers in contaminated change rooms and showers, leave your respirator on until you leave the shower and enter the clean change room.

(4) **Disposal procedures and cleanup.**

(a) Wastes that are generated by processes where asbestos is present include:

(i) Empty asbestos shipping containers.

(ii) Process wastes such as cuttings, trimmings, or reject material.

(iii) Housekeeping waste from sweeping or HEPA vacuuming.

(iv) Asbestos fireproofing or insulating material that is removed from buildings.

(v) Building products that contain asbestos removed during building renovation or demolition.

(vi) Contaminated disposable protective clothing.

(b) Empty shipping bags can be flattened under exhaust hoods and packed into airtight containers for disposal. Empty shipping drums are difficult to clean and should be sealed.

(c) Vacuum bags or disposable paper filters should not be cleaned, but should be sprayed with a fine water mist and placed into a labeled waste container.

WAC 296-62-07747 (Cont.)

(d) Process waste and housekeeping waste should be wetted with water or a mixture of water and surfactant prior to packaging in disposable containers.

(e) Material containing asbestos that is removed from buildings must be disposed of in leaktight 6-mil thick plastic bags, plastic-lined cardboard containers, or plastic-lined metal containers. These wastes, which are removed while wet, should be sealed in containers before they dry out to minimize the release of asbestos fibers during handling.

(5) **Access to information.**

(a) Each year, your employer is required to inform you of the information contained in this standard and appendices for asbestos. In addition, your employer must instruct you in the proper work practices for handling materials containing asbestos and the correct use of protective equipment.

(b) Your employer is required to determine whether you are being exposed to asbestos. You or your representative has the right to observe employee measurements and to record the results obtained. Your employer is required to inform you of your exposure, and, if you are exposed above the permissible limits, he or she is required to inform you of the actions that are being taken to reduce your exposure to within the permissible limits.

(c) Your employer is required to keep records of your exposures and medical examinations. These exposure records must be kept for at least thirty years. Medical records must be kept for the period of your employment plus thirty years.

(d) Your employer is required to release your exposure and medical records to your physician or designated representative upon your written request.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07747, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 89-11-035 (Order 89-03), 296-62-07747, filed 5/15/89, effective 6/30/89; 87-24-051 (Order 87-24), 296-62-07747, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07747, filed 4/27/87.]

WAC 296-62-07749 Appendix H--Medical surveillance guidelines for asbestos--Nonmandatory.

(1) **Route of entry inhalation, ingestion.**

(2) **Toxicology.**

Clinical evidence of the adverse effects associated with exposure to asbestos is present in the form of several well-conducted epidemiological studies of occupationally exposed workers, family contacts of workers, and persons living near asbestos mines. These studies have shown a definite association between exposure to asbestos and an increased incidence of lung cancer, pleural and peretoneal mesothelioma, gastrointestinal cancer, and asbestosis. The latter is a disabling fibrotic lung disease that is caused only by exposure to asbestos. Exposure to asbestos has also been associated with an increased incidence of esophageal, kidney, laryngeal, pharyngeal, and buccal cavity cancers. As with other known chronic occupational diseases, disease associated with asbestos generally appears about twenty years following the first occurrence of exposure: There are no known acute effects associated with exposure to asbestos.

Epidemiological studies indicate that the risk of lung cancer among exposed workers who smoke cigarettes is greatly increased over the risk of lung cancer among nonexposed smokers or exposed nonsmokers. These studies suggest that cessation of smoking will reduce the risk of lung cancer for a person exposed to asbestos but will not reduce it to the same level of risk as that existing for an exposed worker who has never smoked.

WAC 296-62-07749 (Cont.)

(3) **Signs and symptoms of exposure-related disease.**

The signs and symptoms of lung cancer or gastrointestinal cancer induced by exposure to asbestos are not unique, except that a chest x-ray of an exposed patient with lung cancer may show pleural plaques, pleural calcification, or pleural fibrosis. Symptoms characteristic of mesothelioma include shortness of breath, pain in the walls of the chest, or abdominal pain. Mesothelioma has a much longer latency period compared with lung cancer (forty years versus fifteen to twenty years), and mesothelioma is therefore more likely to be found among workers who were first exposed to asbestos at an early age. Mesothelioma is always fatal.

Asbestosis is pulmonary fibrosis caused by the accumulation of asbestos fibers in the lungs. Symptoms include shortness of breath, coughing, fatigue, and vague feelings of sickness. When the fibrosis worsens, shortness of breath occurs even at rest. The diagnosis of asbestosis is based on a history of exposure to asbestos, the presence of characteristic radiologic changes, endinspiratory crackles (rales), and other clinical features of fibrosing lung disease. Pleural plaques and thickening are observed on x-rays taken during the early stages of the disease. Asbestosis is often a progressive disease even in the absence of continued exposure, although this appears to be a highly individualized characteristic. In severe cases, death may be caused by respiratory or cardiac failure.

(4) **Surveillance and preventive considerations.**

As noted above, exposure to asbestos has been linked to an increased risk of lung cancer, mesothelioma, gastrointestinal cancer, and asbestosis among occupationally exposed workers. Adequate screening tests to determine an employee's potential for developing serious chronic diseases, such as cancer, from exposure to asbestos do not presently exist. However, some tests, particularly chest x-rays and pulmonary function tests, may indicate that an employee has been overexposed to asbestos increasing his or her risk of developing exposure-related chronic diseases. It is important for the physician to become familiar with the operating conditions in which occupational exposure to asbestos is likely to occur. This is particularly important in evaluating medical and work histories and in conducting physical examinations. When an active employee has been identified as having been overexposed to asbestos measures taken by the employer to eliminate or mitigate further exposure should also lower the risk of serious long-term consequences.

The employer is required to institute a medical surveillance program for all employees who are or will be exposed to asbestos at or above the permissible exposure limits (0.1 fiber per cubic centimeter of air) for 30 or more days per year and for all employees who are assigned to wear a negative pressure respirator. All examinations and procedures must be performed by or under the supervision of a licensed physician, at a reasonable time and place, and at no cost to the employee.

Although broad latitude is given to the physician in prescribing specific tests to be included in the medical surveillance program, WISHA requires inclusion of the following elements in the routine examination:

(a) Medical and work histories with special emphasis directed to symptoms of the respiratory system, cardiovascular system, and digestive tract.

(b) Completion of the respiratory disease questionnaire contained in WAC 296-62-07741, Appendix D.

(c) A physical examination including a chest roentgenogram and pulmonary function test that includes measurement of the employee's forced vital capacity (FVC) and forced expiratory volume at one second (FEV1).

(d) Any laboratory or other test that the examining physician deems by sound medical practice to be necessary.

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The employer is required to make the prescribed tests available at least annually to those employees covered; more often than specified if recommended by the examining physician; and upon termination of employment.

The employer is required to provide the physician with the following information: A copy of this standard and appendices; a description of the employee's duties as they relate to asbestos exposure; the employee's representative level of exposure to asbestos; a description of any personal protective and respiratory equipment used; and information from previous medical examinations of the affected employee that is not otherwise available to the physician. Making this information available to the physician will aid in the evaluation of the employee's health in relation to assigned duties and fitness to wear personal protective equipment, if required.

The employer is required to obtain a written opinion from the examining physician containing the results of the medical examination; the physician's opinion as to whether the employee has any detected medical conditions that would place the employee at an increased risk of exposure-related disease; any recommended limitations on the employee or on the use of personal protective equipment; and a statement that the employee has been informed by the physician of the results of the medical examination and of any medical conditions related to asbestos exposure that require further explanation or treatment. This written opinion must not reveal specific findings or diagnoses unrelated to exposure to asbestos and a copy of the opinion must be provided to the affected employee.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07749, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-07749, filed 7/20/94, effective 9/20/94; 87-24-051 (Order 87-24), 296-62-07749, filed 11/30/87. Statutory Authority: RCW 49.17.050(2) and 49.17.040. 87-10-008 (Order 87-06), 296-62-07749, filed 4/27/87.]

WAC 296-62-07751 Appendix I--Work practices and engineering controls for Class I asbestos operations--Nonmandatory. This is a nonmandatory appendix to the asbestos standards for construction and for shipyards. It describes criteria and procedures for erecting and using negative pressure enclosures for Class I Asbestos Work, when NPEs are used as an allowable control method to comply with WAC 296-62-07712 (7)(a). Many small and variable details are involved in the erection of a negative pressure enclosure. OSHA and most participants in the rulemaking agreed that only the major, more performance oriented criteria should be made mandatory. These criteria are set out in WAC 296-62-07712.

In addition, this appendix includes these mandatory specifications and procedures in its guidelines in order to make this appendix coherent and helpful. The mandatory nature of the criteria which appear in the regulatory text is not changed because they are included in this “nonmandatory” appendix. Similarly, the additional criteria and procedures included as guidelines in the appendix, do not become mandatory because mandatory criteria are also included in these comprehensive guidelines.

In addition, none of the criteria, both mandatory and recommended, are meant to specify or imply the need for use of patented or licensed methods or equipment. Recommended specifications included in this attachment should not discourage the use of creative alternatives which can be shown to reliably achieve the objectives of negative-pressure enclosures.

Requirements included in this appendix, cover general provisions to be followed in all asbestos jobs, provisions which must be followed for all Class I asbestos jobs, and provisions governing the construction and testing of negative pressure enclosures. The first category includes the requirement for use of wet methods, HEPA vacuums, and immediate bagging of waste; Class I work must conform to the following provisions:

- oversight by competent person
- use of critical barriers over all openings to work area
- isolation of HVAC systems

WAC 296-62-07751 (Cont.)

- use of impermeable dropcloths and coverage of all objects within regulated areas

In addition, more specific requirements for NPEs include:

- maintenance of -0.02 inches water gauge within enclosure
- manometric measurements
- air movement away from employees performing removal work
- smoke testing or equivalent for detection of leaks and air direction
- deactivation of electrical circuits, if not provided with ground-fault circuit interrupters.

Planning the Project

The standard requires that an exposure assessment be conducted before the asbestos job is begun WAC 296-62-07709(3). Information needed for that assessment, includes data relating to prior similar jobs, as applied to the specific variables of the current job. The information needed to conduct the assessment will be useful in planning the project, and in complying with any reporting requirements under this standard, when significant changes are being made to a control system listed in the standard, (see WAC 296-62-07719), as well as those of USEPA (40 CFR Part 61, subpart M). Thus, although the standard does not explicitly require the preparation of a written asbestos removal plan, the usual constituents of such a plan, i.e., a description of the enclosure, the equipment, and the procedures to be used throughout the project, must be determined before the enclosure can be erected. The following information should be included in the planning of the system:

A physical description of the work area;

A description of the approximate amount of material to be removed;

A schedule for turning off and sealing existing ventilation systems;

Personnel hygiene procedures;

A description of personal protective equipment and clothing to be worn by employees;

A description of the local exhaust ventilation systems to be used and how they are to be tested;

A description of work practices to be observed by employees;

An air monitoring plan;

A description of the method to be used to transport waste material; and

The location of the dump site.

Materials and Equipment Necessary for Asbestos Removal

Although individual asbestos removal projects vary in terms of the equipment required to accomplish the removal of the materials, some equipment and materials are common to most asbestos removal operations.

WAC 296-62-07751 (Cont.)

Plastic sheeting used to protect horizontal surfaces, seal HVAC openings or to seal vertical openings and ceilings should have a minimum thickness of 6 mils. Tape or other adhesive used to attach plastic sheeting should be of sufficient adhesive strength to support the weight of the material plus all stresses encountered during the entire duration of the project without becoming detached from the surface.

Other equipment and materials which should be available at the beginning of each project are:

- HEPA Filtered Vacuum is essential for cleaning the work area after the asbestos has been removed. It should have a long hose capable of reaching out-of-the-way places, such as areas above ceiling tiles, behind pipes, etc.

- Portable air ventilation systems installed to provide the negative air pressure and air removal from the enclosure must be equipped with a HEPA filter. The number and capacity of units required to ventilate an enclosure depend on the size of the area to be ventilated. The filters for these systems should be designed in such a manner that they can be replaced when the air flow volume is reduced by the build-up of dust in the filtration material. Pressure monitoring devices with alarms and strip chart recorders attached to each system to indicate the pressure differential and the loss due to dust buildup on the filter are recommended.

- Water sprayers should be used to keep the asbestos material as saturated as possible during removal; the sprayers will provide a fine mist that minimizes the impact of the spray on the material.

- Water used to saturate the asbestos containing material can be amended by adding at least 15 milliliters (0.5 ounce) of wetting agent in 1 liter (1 pint) of water. An example of a wetting agent is a 50/50 mixture of polyoxyethylene ether and polyoxyethylene polyglycol ester.

- Backup power supplies are recommended, especially for ventilation systems.

- Shower and bath water should be with mixed hot and cold water faucets. Water that has been used to clean personnel or equipment should either be filtered or be collected and discarded as asbestos waste. Soap and shampoo should be provided to aid in removing dust from the workers' skin and hair.

- See WAC 296-62-07715 and 296-62-07717 for appropriate respiratory protection and protective clothing.

- See WAC 296-62-07721 for required signs and labels.

Preparing the Work Area

Disabling HVAC Systems: The power to the heating, ventilation, and air conditioning systems that service the restricted area must be deactivated and locked off. All ducts, grills, access ports, windows and vents must be sealed off with two layers of plastic to prevent entrainment of contaminated air.

Operating HVAC Systems in the Restricted Area: If components of a HVAC system located in the restricted area are connected to a system that will service another zone during the project, the portion of the duct in the restricted area must be sealed and pressurized. Necessary precautions include caulking the duct joints, covering all cracks and openings with two layers of sheeting, and pressurizing the duct throughout the duration of the project by restricting the return air flow. The power to the fan supplying the positive pressure should be locked “on” to prevent pressure loss.

WAC 296-62-07751 (Cont.)

Sealing Elevators: If an elevator shaft is located in the restricted area, it should be either shut down or isolated by sealing with two layers of plastic sheeting. The sheeting should provide enough slack to accommodate the pressure changes in the shaft without breaking the air-tight seal.

Removing Mobile Objects: All movable objects should be cleaned and removed from the work area before an enclosure is constructed unless moving the objects creates a hazard. Mobile objects will be assumed to be contaminated and should be either cleaned with amended water and a HEPA vacuum and then removed from the area or wrapped and then disposed of as hazardous waste.

Cleaning and Sealing Surfaces: After cleaning with water and a HEPA vacuum, surfaces of stationary objects should be covered with two layers of plastic sheeting. The sheeting should be secured with duct tape or an equivalent method to provide a tight seal around the object.

Bagging Waste: In addition to the requirement for immediate bagging of waste for disposal, it is further recommended that the waste material be double-bagged and sealed in plastic bags designed for asbestos disposal. The bags should be stored in a waste storage area that can be controlled by the workers conducting the removal. Filters removed from air handling units and rubbish removed from the area are to be bagged and handled as hazardous waste.

Constructing the Enclosure

The enclosure should be constructed to provide an air-tight seal around ducts and openings into existing ventilation systems and around penetrations for electrical conduits, telephone wires, water lines, drain pipes, etc. Enclosures should be both airtight and watertight except for those openings designed to provide entry and/or air flow control.

Size: An enclosure should be the minimum volume to encompass all of the working surfaces yet allow unencumbered movement by the worker(s), provide unrestricted air flow past the worker(s), and ensure walking surfaces can be kept free of tripping hazards.

Shape: The enclosure may be any shape that optimizes the flow of ventilation air past the worker(s).

Structural Integrity: The walls, ceilings and floors must be supported in such a manner that portions of the enclosure will not fall down during normal use.

Openings: It is not necessary that the structure be airtight; openings may be designed to direct air flow. Such openings should be located at a distance from active removal operations. They should be designed to draw air into the enclosure under all anticipated circumstances. In the event that negative pressure is lost, they should be fitted with either HEPA filters to trap dust or automatic trap doors that prevent dust from escaping the enclosure. Openings for exits should be controlled by an airlock or a vestibule.

Barrier Supports: Frames should be constructed to support all unsupported spans of sheeting.

Sheeting: Walls, barriers, ceilings, and floors should be lined with two layers of plastic sheeting having a thickness of at least 6 mil.

Seams: Seams in the sheeting material should be minimized to reduce the possibilities of accidental rips and tears in the adhesive or connections. All seams in the sheeting should overlap, be staggered and not be located at corners or wall-to-floor joints.

Areas Within an Enclosure: Each enclosure consists of a work area, a decontamination area, and waste storage area. The work area where the asbestos removal operations occur should be separated from both the waste storage area and the contamination control area by physical curtains, doors, and/or airflow patterns that force any airborne contamination back into the work area.

WAC 296-62-07751 (Cont.)

See WAC 296-62-07719 for requirements for hygiene facilities.

During egress from the work area, each worker should step into the equipment room, clean tools and equipment, and remove gross contamination from clothing by wet cleaning and HEPA vacuuming. Before entering the shower area, foot coverings, head coverings, hand coverings, and coveralls are removed and placed in impervious bags for disposal or cleaning. Airline connections from airline respirators with HEPA disconnects and power cables from powered air-purifying respirators (PAPRs) will be disconnected just prior to entering the shower room.

Establishing Negative Pressure Within the Enclosure

Negative Pressure: Air is to be drawn into the enclosure under all anticipated conditions and exhausted through a HEPA filter for 24 hours a day during the entire duration of the project.

Air Flow Tests: Air flow patterns will be checked before removal operations begin, at least once per operating shift and any time there is a question regarding the integrity of the enclosure. The primary test for air flow is to trace air currents with smoke tubes or other visual methods. Flow checks are made at each opening and at each doorway to demonstrate that air is being drawn into the enclosure and at each worker's position to show that air is being drawn away from the breathing zone.

Monitoring Pressure Within the Enclosure: After the initial air flow patterns have been checked, the static pressure must be monitored within the enclosure. Monitoring may be made using manometers, pressure gauges, or combinations of these devices. It is recommended that they be attached to alarms and strip chart recorders at points identified by the design engineer.

Corrective Actions: If the manometers or pressure gauges demonstrate a reduction in pressure differential below the required level, work should cease and the reason for the change investigated and appropriate changes made. The air flow patterns should be retested before work begins again.

Pressure Differential: The design parameters for static pressure differentials between the inside and outside of enclosures typically range from 0.02 to 0.10 inches of water gauge, depending on conditions. All zones inside the enclosure must have less pressure than the ambient pressure outside of the enclosure (-0.02 inches water gauge differential). Design specifications for the differential vary according to the size, configuration, and shape of the enclosure as well as ambient and mechanical air pressure conditions around the enclosure.

Air Flow Patterns: The flow of air past each worker shall be enhanced by positioning the intakes and exhaust ports to remove contaminated air from the worker's breathing zone, by positioning HEPA vacuum cleaners to draw air from the worker's breathing zone, by forcing relatively uncontaminated air past the worker toward an exhaust port, or by using a combination of methods to reduce the worker's exposure.

Air Handling Unit Exhaust: The exhaust plume from air handling units should be located away from adjacent personnel and intakes for HVAC systems.

Air Flow Volume: The air flow volume (cubic meters per minute) exhausted (removed) from the workplace must exceed the amount of makeup air supplied to the enclosure. The rate of air exhausted from the enclosure should be designed to maintain a negative pressure in the enclosure and air movement past each worker. The volume of air flow removed from the enclosure should replace the volume of the container at every 5 to 15 minutes. Air flow volume will need to be relatively high for large enclosures, enclosures with awkward shapes, enclosures with multiple openings, and operations employing several workers in the enclosure.

Air Flow Velocity: At each opening, the air flow velocity must visibly “drag” air into the enclosure. The velocity of air flow within the enclosure must be adequate to remove airborne contamination from each worker's breathing zone without disturbing the asbestos-containing material on surfaces.

WAC 296-62-07751 (Cont.)

Airlocks: Airlocks are mechanisms on doors and curtains that control the air flow patterns in the doorways. If air flow occurs, the patterns through doorways must be such that the air flows toward the inside of the enclosure. Sometimes vestibules, double doors, or double curtains are used to prevent air movement through the doorways. To use a vestibule, a worker enters a chamber by opening the door or curtain and then closing the entry before opening the exit door or curtain.

Airlocks should be located between the equipment room and shower room, between the shower room and the clean room, and between the waste storage area and the outside of the enclosure. The air flow between adjacent rooms must be checked using smoke tubes or other visual tests to ensure the flow patterns draw air toward the work area without producing eddies.

Monitoring for Airborne Concentrations

In addition to the breathing zone samples taken as outlined in WAC 296-62-07709, samples of air should be taken to demonstrate the integrity of the enclosure, the cleanliness of the clean room and shower area, and the effectiveness of the HEPA filter. If the clean room is shown to be contaminated, the room must be relocated to an uncontaminated area.

Samples taken near the exhaust of portable ventilation systems must be done with care.

General Work Practices

Preventing dust dispersion is the primary means of controlling the spread of asbestos within the enclosure. Whenever practical, the point of removal should be isolated, enclosed, covered, or shielded from the workers in the area. Waste asbestos containing materials must be bagged during or immediately after removal; the material must remain saturated until the waste container is sealed.

Waste material with sharp points or corners must be placed in hard air-tight containers rather than bags.

Whenever possible, large components should be sealed in plastic sheeting and removed intact.

Bags or containers of waste will be moved to the waste holding area, washed, and wrapped in a bag with the appropriate labels.

Cleaning the Work Area

Surfaces within the work area should be kept free of visible dust and debris to the extent feasible. Whenever visible dust appears on surfaces, the surfaces within the enclosure must be cleaned by wiping with a wet sponge, brush, or cloth and then vacuumed with a HEPA vacuum.

All surfaces within the enclosure should be cleaned before the exhaust ventilation system is deactivated and the enclosure is disassembled. An approved encapsulant may be sprayed onto areas after the visible dust has been removed.

[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07751, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-07751, filed 7/20/94, effective 9/20/94; 87-24-051 (Order 87-24), 296-62-07751, filed 11/30/87.]

WAC 296-62-07753 Appendix J--Polarized light microscopy of asbestos--Nonmandatory.

Method number: ID-191

Matrix: Bulk

Collection Procedure

WAC 296-62-07753 (Cont.)

Collect approximately 1 to 2 grams of each type of material and place into separate 20 mL scintillation vials.

Analytical Procedure

A portion of each separate phase is analyzed by gross examination, phase-polar examination, and central stop dispersion microscopy.

Commercial manufacturers and products mentioned in this method are for descriptive use only and do not constitute endorsements by USDOL-WISHA. Similar products from other sources may be substituted.

(1) **Introduction**

This method describes the collection and analysis of asbestos bulk materials by light microscopy techniques including phase- polar illumination and central-stop dispersion microscopy. Some terms unique to asbestos analysis are defined below:

Amphibole: A family of minerals whose crystals are formed by long, thin units which have two thin ribbons of double chain silicate with a brucite ribbon in between. The shape of each unit is similar to an "I beam." Minerals important in asbestos analysis include cummingtonite-grunerite, crocidolite, tremolite-actinolite and anthophyllite.

Asbestos: A term for naturally occurring fibrous minerals. Asbestos includes chrysotile, cummingtonite-grunerite asbestos (amosite), anthophyllite asbestos, tremolite asbestos, crocidolite, actinolite asbestos and any of these minerals which have been chemically treated or altered. The precise chemical formulation of each species varies with the location from which it was mined. Nominal compositions are listed:

Chrysotile	$Mg_3Si_2O_5(OH)_4$
Crocidolite (Riebeckite asbestos)	$Na_2Fe_3^{2+}Fe_2^{3+}Si_8O_{22}(OH)_2$
Cummingtonite-Grunerite asbestos (Amosite)	$(Mg,Fe)_7Si_8O_{22}(OH)_2$
Tremolite-Actinolite asbestos	$Ca_2(Mg,Fe)_5Si_8O_{22}(OH)_2$
Anthophyllite asbestos	$(Mg,Fe)_7Si_8O_{22}(HO)_2$
Asbestos Fiber:	A fiber of asbestos meeting the criteria for a fiber. (See section (3)(e))

Aspect Ratio: The ratio of the length of a fiber to its diameter usually defined as "length: width", e.g. 3:1.

Brucite: A sheet mineral with the composition $mg(OH)_2$.

Central Stop Dispersion Staining (microscope): This is a dark field microscope technique that images particles using only light refracted by the particle, excluding light that travels through the particle unrefracted. This is usually accomplished with a McCrone objective or other arrangement which places a circular stop with apparent aperture equal to the objective aperture in the back focal plane of the microscope.

Cleavage Fragments: Mineral particles formed by the comminution of minerals, especially those characterized by relatively parallel sides and moderate aspect ratio.

WAC 296-62-07753 (Cont.)

Differential Counting: The term applied to the practice of excluding certain kinds of fibers from a phase contrast asbestos count because they are not asbestos.

Fiber: A particle longer than or equal to 5 microns with a length to width ratio greater than or equal to 3:1. This may include cleavage fragments. (See section (3)(e) of this appendix).

Phase Contrast: Contrast obtained in the microscope by causing light scattered by small particles to destructively interfere with unscattered light, thereby enhancing the visibility of very small particles and particles with very low intrinsic contrast.

Phase Contrast Microscope: A microscope configured with a phase mask pair to create phase contrast. The technique which uses this is called Phase Contrast Microscopy (PCM).

Phase-Polar Analysis: This is the use of polarized light in a phase contrast microscope. It is used to see the same size fibers that are visible in air filter analysis. Although fibers finer than 1 micron are visible, analysis of these is inferred from analysis of larger bundles that are usually present.

Phase-Polar Microscope: The phase-polar microscope is a phase contrast microscope which has an analyzer, a polarizer, a first order red plate and a rotating phase condenser all in place so that the polarized light image is enhanced by phase contrast.

Sealing Encapsulant: This is a product which can be applied, preferably by spraying, onto an asbestos surface which will seal the surface so that fibers cannot be released.

Serpentine: A mineral family consisting of minerals with the general composition $Mg_3(Si_2O_5(OH)_4$ having the magnesium in brucite layer over a silicate layer. Minerals important in asbestos analysis included in this family are chrysotile, lizardite, antigorite.

(a) History

Light microscopy has been used for well over 100 years for the determination of mineral species. This analysis is carried out using specialized polarizing microscopes as well as bright field microscopes. The identification of minerals is an on-going process with many new minerals described each year. The first recorded use of asbestos was in Finland about 2500 B.C. where the material was used in the mud wattle for the wooden huts the people lived in as well as strengthening for pottery. Adverse health aspects of the mineral were noted nearly 2000 years ago when Pliny the Younger wrote about the poor health of slaves in the asbestos mines. Although known to be injurious for centuries, the first modern references to its toxicity were by the British Labor Inspectorate when it banned asbestos dust from the workplace in 1898. Asbestosis cases were described in the literature after the turn of the century. Cancer was first suspected in the mid 1930's and a causal link to mesothelioma was made in 1965. Because of the public concern for worker and public safety with the use of this material, several different types of analysis were applied to the determination of asbestos content. Light microscopy requires a great deal of experience and craft. Attempts were made to apply less subjective methods to the analysis. X-ray diffraction was partially successful in determining the mineral types but was unable to separate out the fibrous portions from the nonfibrous portions. Also, the minimum detection limit for asbestos analysis by X-ray diffraction (XRD) is about 1%. Differential Thermal Analysis (DTA) was no more successful. These provide useful corroborating information when the presence of asbestos has been shown by microscopy; however, neither can determine the difference between fibrous and nonfibrous minerals when both habits are present. The same is true of Infrared Absorption (IR).

WAC 296-62-07753 (Cont.)

When electron microscopy was applied to asbestos analysis, hundreds of fibers were discovered present too small to be visible in any light microscope. There are two different types of electron microscopes used for asbestos analysis: Scanning Electron Microscope (SEM) and Transmission Electron Microscope (TEM). Scanning Electron Microscopy is useful in identifying minerals. The SEM can provide two of the three pieces of information required to identify fibers by electron microscopy: Morphology and chemistry. The third is structure as determined by Selected Area Electron Diffraction-SAED which is performed in the TEM. Although the resolution of the SEM is sufficient for very fine fibers to be seen, accuracy of chemical analysis that can be performed on the fibers varies with fiber diameter in fibers of less than 0.2 micron diameter. The TEM is a powerful tool to identify fibers too small to be resolved by light microscopy and should be used in conjunction with this method when necessary. The TEM can provide all three pieces of information required for fiber identification. Most fibers thicker than 1 micron can adequately be defined in the light microscope. The light microscope remains as the best instrument for the determination of mineral type. This is because the minerals under investigation were first described analytically with the light microscope. It is inexpensive and gives positive identification for most samples analyzed. Further, when optical techniques are inadequate, there is ample indication that alternative techniques should be used for complete identification of the sample.

(b) Principle

Minerals consist of atoms that may be arranged in random order or in a regular arrangement. Amorphous materials have atoms in random order while crystalline materials have long range order. Many materials are transparent to light, at least for small particles or for thin sections. The properties of these materials can be investigated by the effect that the material has on light passing through it. The six asbestos minerals are all crystalline with particular properties that have been identified and cataloged. These six minerals are anisotropic. They have a regular array of atoms, but the arrangement is not the same in all directions. Each major direction of the crystal presents a different regularity. Light photons traveling in each of these main directions will encounter different electrical neighborhoods, affecting the path and time of travel. The techniques outlined in this method use the fact that light traveling through fibers or crystals in different directions will behave differently, but predictably. The behavior of the light as it travels through a crystal can be measured and compared with known or determined values to identify the mineral species. Usually, Polarized Light Microscopy (PLM) is performed with strain-free objectives on a bright-field microscope platform. This would limit the resolution of the microscope to about 0.4 micron. Because WISHA requires the counting and identification of fibers visible in phase contrast, the phase contrast platform is used to visualize the fibers with the polarizing elements added into the light path. Polarized light methods cannot identify fibers finer than about 1 micron in diameter even though they are visible. The finest fibers are usually identified by inference from the presence of larger, identifiable fiber bundles. When fibers are present, but not identifiable by light microscopy, use either SEM or TEM to determine the fiber identity.

(c) Advantages and Disadvantages

The advantages of light microscopy are:

(i) Basic identification of the materials was first performed by light microscopy and gross analysis. This provides a large base of published information against which to check analysis and analytical technique.

(ii) The analysis is specific to fibers. The minerals present can exist in asbestiform, fibrous, prismatic, or massive varieties all at the same time. Therefore, bulk methods of analysis such as X-ray diffraction, IR analysis, DTA, etc. are inappropriate where the material is not known to be fibrous.

WAC 296-62-07753 (Cont.)

(iii) The analysis is quick, requires little preparation time, and can be performed on-site if a suitably equipped microscope is available.

The disadvantages are:

(iv) Even using phase-polar illumination, not all the fibers present may be seen. This is a problem for very low asbestos concentrations where agglomerations or large bundles of fibers may not be present to allow identification by inference.

(v) The method requires a great degree of sophistication on the part of the microscopist. An analyst is only as useful as his mental catalog of images. Therefore, a microscopist's accuracy is enhanced by experience. The mineralogical training of the analyst is very important. It is the basis on which subjective decisions are made.

(vi) The method uses only a tiny amount of material for analysis. This may lead to sampling bias and false results (high or low). This is especially true if the sample is severely inhomogeneous.

(vii) Fibers may be bound in a matrix and not distinguishable as fibers so identification cannot be made.

(d) Method Performance

(i) This method can be used for determination of asbestos content from 0 to 100% asbestos. The detection limit has not been adequately determined, although for selected samples, the limit is very low, depending on the number of particles examined. For mostly homogeneous, finely divided samples, with no difficult fibrous interferences, the detection limit is below 1%. For inhomogeneous samples (most samples), the detection limit remains undefined. NIST has conducted proficiency testing of laboratories on a national scale. Although each round is reported statistically with an average, control limits, etc., the results indicate a difficulty in establishing precision especially in the low concentration range. It is suspected that there is significant bias in the low range especially near 1%. EPA tried to remedy this by requiring a mandatory point counting scheme for samples less than 10%. The point counting procedure is tedious, and may introduce significant biases of its own. It has not been incorporated into this method.

(ii) The precision and accuracy of the quantitation tests performed in this method are unknown. Concentrations are easier to determine in commercial products where asbestos was deliberately added because the amount is usually more than a few percent. An analyst's results can be “calibrated” against the known amounts added by the manufacturer. For geological samples, the degree of homogeneity affects the precision.

(iii) The performance of the method is analyst dependent. The analyst must choose carefully and not necessarily randomly the portions for analysis to assure that detection of asbestos occurs when it is present. For this reason, the analyst must have adequate training in sample preparation, and experience in the location and identification of asbestos in samples. This is usually accomplished through substantial on-the-job training as well as formal education in mineralogy and microscopy.

WAC 296-62-07753 (Cont.)

(e) Interferences

Any material which is long, thin, and small enough to be viewed under the microscope can be considered an interference for asbestos. There are literally hundreds of interferences in workplaces. The techniques described in this method are normally sufficient to eliminate the interferences. An analyst's success in eliminating the interferences depends on proper training.

Asbestos minerals belong to two mineral families: The serpentines and the amphiboles. In the serpentine family, the only common fibrous mineral is chrysotile. Occasionally, the mineral antigorite occurs in a fibril habit with morphology similar to the amphiboles. The amphibole minerals consist of a score of different minerals of which only five are regulated by federal standard: Amosite, crocidolite, anthophyllite asbestos, tremolite asbestos and actinolite asbestos. These are the only amphibole minerals that have been commercially exploited for their fibrous properties; however, the rest can and do occur occasionally in asbestiform habit.

In addition to the related mineral interferences, other minerals common in building material may present a problem for some microscopists: Gypsum, anhydrite, brucite, quartz fibers, talc fibers or ribbons, wollastonite, perlite, attapulgite, etc. Other fibrous materials commonly present in workplaces are: Fiberglass, mineral wool, ceramic wool, refractory ceramic fibers, kevlar, nomex, synthetic fibers, graphite or carbon fibers, cellulose (paper or wood) fibers, metal fibers, etc.

Matrix embedding material can sometimes be a negative interference. The analyst may not be able to easily extract the fibers from the matrix in order to use the method. Where possible, remove the matrix before the analysis, taking careful note of the loss of weight. Some common matrix materials are: Vinyl, rubber, tar, paint, plant fiber, cement, and epoxy. A further negative interference is that the asbestos fibers themselves may be either too small to be seen in Phase Contrast Microscopy (PCM) or of a very low fibrous quality, having the appearance of plant fibers. The analyst's ability to deal with these materials increases with experience.

(f) Uses and Occupational Exposure

Asbestos is ubiquitous in the environment. More than 40% of the land area of the United States is composed of minerals which may contain asbestos. Fortunately, the actual formation of great amounts of asbestos is relatively rare. Nonetheless, there are locations in which environmental exposure can be severe such as in the Serpentine Hills of California.

There are thousands of uses for asbestos in industry and the home. Asbestos abatement workers are the most current segment of the population to have occupational exposure to great amounts of asbestos. If the material is undisturbed, there is no exposure. Exposure occurs when the asbestos-containing material is abraded or otherwise disturbed during maintenance operations or some other activity. Approximately 95% of the asbestos in place in the United States is chrysotile.

Amosite and crocidolite make up nearly all the difference. Tremolite and anthophyllite make up a very small percentage. Tremolite is found in extremely small amounts in certain chrysotile deposits. Actinolite exposure is probably greatest from environmental sources, but has been identified in vermiculite containing, sprayed-on insulating materials which may have been certified as asbestos-free.

(g) Physical and Chemical Properties

The nominal chemical compositions for the asbestos minerals were given in subsection (1). Compared to cleavage fragments of the same minerals, asbestiform fibers possess a high tensile strength along the fiber axis. They are chemically inert, noncombustible, and heat resistant.

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Except for chrysotile, they are insoluble in Hydrochloric acid (HCl). Chrysotile is slightly soluble in HCl. Asbestos has high electrical resistance and good sound absorbing characteristics. It can be woven into cables, fabrics or other textiles, or matted into papers, felts, and mats.

(h) Toxicology (This Section is for Information Only and Should Not Be Taken as WISHA Policy).

Possible physiologic results of respiratory exposure to asbestos are mesothelioma of the pleura or peritoneum, interstitial fibrosis, asbestosis, pneumoconiosis, or respiratory cancer.

The possible consequences of asbestos exposure are detailed in the NIOSH Criteria Document or in the WISHA Asbestos Standards, WAC 296-62-077.

(2) **Sampling Procedure**

(a) Equipment for Sampling

(i) Tube or cork borer sampling device

(ii) Knife

(iii) 20 mL scintillation vial or similar vial

(iv) Sealing encapsulant

(b) Safety Precautions

Asbestos is a known carcinogen. Take care when sampling. While in an asbestos-containing atmosphere, a properly selected and fit-tested respirator should be worn. Take samples in a manner to cause the least amount of dust. Follow these general guidelines:

(i) Do not make unnecessary dust.

(ii) Take only a small amount (1 to 2 g).

(iii) Tightly close the sample container.

(iv) Use encapsulant to seal the spot where the sample was taken, if necessary.

(c) Sampling procedure

Samples of any suspect material should be taken from an inconspicuous place. Where the material is to remain, seal the sampling wound with an encapsulant to eliminate the potential for exposure from the sample site. Microscopy requires only a few milligrams of material. The amount that will fill a 20 mL scintillation vial is more than adequate. Be sure to collect samples from all layers and phases of material. If possible, make separate samples of each different phase of the material. This will aid in determining the actual hazard. do not use envelopes, plastic or paper bags of any kind to collect samples. The use of plastic bags presents a contamination hazard to laboratory personnel and to other samples. When these containers are opened, a bellows effect blows fibers out of the container onto everything, including the person opening the container. If a cork-borer type sampler is available, push the tube through the material all the way, so that all layers of material are sampled. Some samplers are intended to be disposable. These should be capped and sent to the laboratory. If a nondisposable cork borer is used, empty the contents into a scintillation vial and send to the laboratory. Vigorously and completely clean the cork borer between samples.

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(d) Shipment

Samples packed in glass vials must not touch or they might break in shipment.

(i) Seal the samples with a sample seal over the end to guard against tampering and to identify the sample.

(ii) Package the bulk samples in separate packages from the air samples. They may cross-contaminate each other and will invalidate the results of the air samples.

(iii) Include identifying paperwork with the samples, but not in contact with the suspected asbestos.

(iv) To maintain sample accountability, ship the samples by certified mail, overnight express, or hand carry them to the laboratory.

(3) **Analysis**

The analysis of asbestos samples can be divided into two major parts: Sample preparation and microscopy. Because of the different asbestos uses that may be encountered by the analyst, each sample may need different preparation steps. The choices are outlined below. There are several different tests that are performed to identify the asbestos species and determine the percentage. They will be explained below.

(a) Safety

(i) Do not create unnecessary dust. Handle the samples in HEPA-filter equipped hoods. If samples are received in bags, envelopes or other inappropriate container, open them only in a hood having a face velocity at or greater than 100 fpm. Transfer a small amount to a scintillation vial and only handle the smaller amount.

(ii) Open samples in a hood, never in the open lab area.

(iii) Index of refraction oils can be toxic. Take care not to get this material on the skin. Wash immediately with soap and water if this happens.

(iv) Samples that have been heated in the muffle furnace or the drying oven may be hot. Handle them with tongs until they are cool enough to handle.

(v) Some of the solvents used, such as THF (tetrahydrofuran), are toxic and should only be handled in an appropriate fume hood and according to instructions given in the Material Safety Data Sheet (MSDS).

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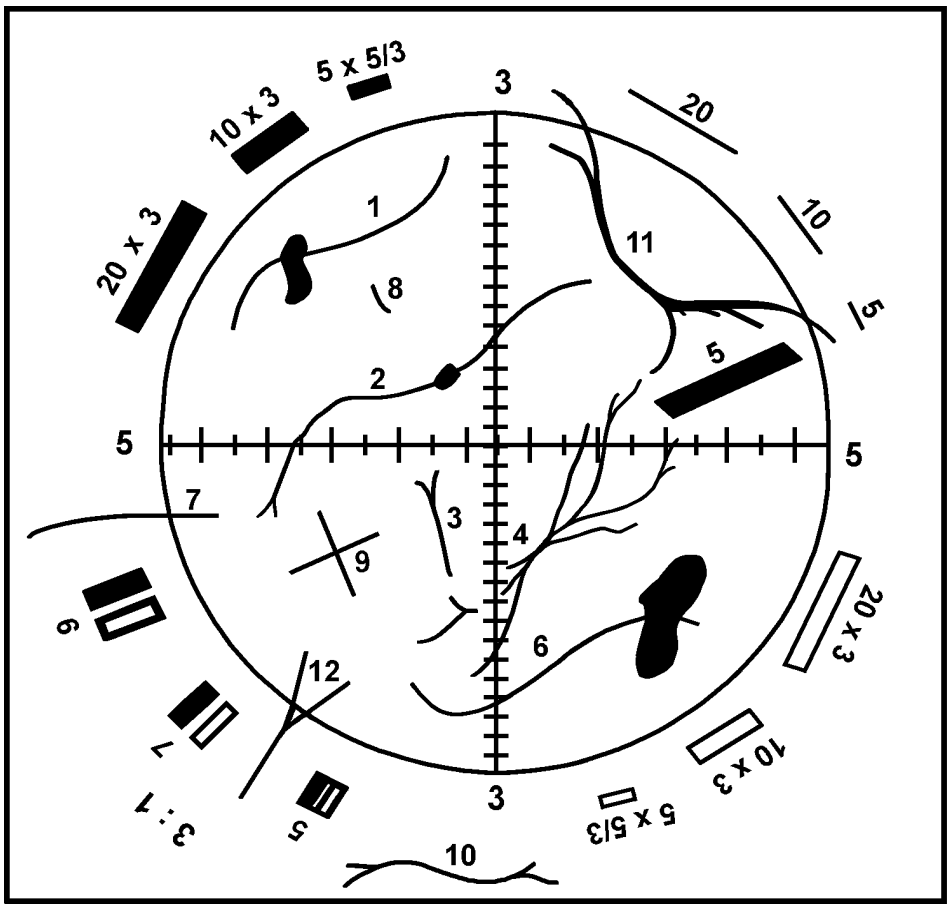

Figure 1: Walton-Beckett Graticule with some explanatory fibers.

Counts for the Fibers in the Figure

Structure No.	Count	Explanation
1 to 6	1	Single fibers all contained within the circle.
7	1/2	Fiber crosses circle once.
8	0	Fiber too short.
9	2	Two crossing fibers.
10	0	Fiber outside graticule.
11	0	Fiber crosses graticule twice.
12	1/2	Although split, fiber only crosses once.

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(b) Equipment

(i) Phase contrast microscope with 10x, 16x and 40x objectives, 10x wide-field eyepieces, G-22 Walton-Beckett graticule, Whipple disk, polarizer, analyzer and first order red or gypsum plate, 100 Watt illuminator, rotating position condenser with oversize phase rings, central stop dispersion objective, Kohler illumination and a rotating mechanical stage. (See Figure 1).

(ii) Stereo microscope with reflected light illumination, transmitted light illumination, polarizer, analyzer and first order red or gypsum plate, and rotating stage.

(iii) Negative pressure hood for the stereo microscope

(iv) Muffle furnace capable of 600 degrees C

(v) Drying oven capable of 50-150 degrees C

(vi) Aluminum specimen pans

(vii) Tongs for handling samples in the furnace

(viii) High dispersion index of refraction oils (Special for dispersion staining.)

n = 1.550

n = 1.585

n = 1.590

n = 1.605

n = 1.620

n = 1.670

n = 1.680

n = 1.690

(ix) A set of index of refraction oils from about n = 1.350 to n = 2.000 in n = 0.005 increments. (Standard for Becke line analysis.)

(x) Glass slides with painted or frosted ends 1 x 3 inches 1mm thick, precleaned.

(xi) Cover Slips 22 x 22 mm, #1 1/2

(xii) Paper clips or dissection needles

(xiii) Hand grinder

(xiv) Scalpel with both #10 and #11 blades

(xv) 0.1 molar HCl

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(xvi) Decalcifying solution (Baxter Scientific Products) Ethylenediaminetetraacetic Acid,

(xvii) Tetrasodium....0.7 g/l

Sodium Potassium Tartrate....8.0 mg/liter

Hydrochloric Acid....99.2 g/liter

Sodium Tartrate....0.14 g/liter

Tetrahydrofuran (THF)

(xviii) Hotplate capable of 60 degrees C

(xix) Balance

(xx) Hacksaw blade

(xxi) Ruby mortar and pestle

(c) Sample Pre-Preparation

Sample preparation begins with pre-preparation which may include chemical reduction of the matrix, heating the sample to dryness or heating in the muffle furnace. The end result is a sample which has been reduced to a powder that is sufficiently fine to fit under the cover slip. Analyze different phases of samples separately, e.g., tile and the tile mastic should be analyzed separately as the mastic may contain asbestos while the tile may not.

(i) Wet Samples

Samples with a high water content will not give the proper dispersion colors and must be dried prior to sample mounting. Remove the lid of the scintillation vial, place the bottle in the drying oven and heat at 100 degrees C to dryness (usually about 2 h). Samples which are not submitted to the lab in glass must be removed and placed in glass vials or aluminum weighing pans before placing them in the drying oven.

(ii) Samples With Organic Interference-Muffle Furnace

These may include samples with tar as a matrix, vinyl asbestos tile, or any other organic that can be reduced by heating. Remove the sample from the vial and weigh in a balance to determine the weight of the submitted portion. Place the sample in a muffle furnace at 500 degrees C for 1 to 2 h or until all obvious organic material has been removed. Retrieve, cool and weigh again to determine the weight loss on ignition. This is necessary to determine the asbestos content of the submitted sample, because the analyst will be looking at a reduced sample.

Notes: Heating above 600 degrees C will cause the sample to undergo a structural change which, given sufficient time, will convert the chrysotile to forsterite. Heating even at lower temperatures for 1 to 2 h may have a measurable effect on the optical properties of the minerals. If the analyst is unsure of what to expect, a sample of standard asbestos should be heated to the same temperature for the same length of time so that it can be examined for the proper interpretation.

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(iii) Samples With Organic Interference-THF

Vinyl asbestos tile is the most common material treated with this solvent, although, substances containing tar will sometimes yield to this treatment. Select a portion of the material and then grind it up if possible. Weigh the sample and place it in a test tube. Add sufficient THF to dissolve the organic matrix. This is usually about 4 to 5 mL. Remember, THF is highly flammable. Filter the remaining material through a tared silver membrane, dry and weigh to determine how much is left after the solvent extraction. Further process the sample to remove carbonate or mount directly.

(iv) Samples With Carbonate Interference

Carbonate material is often found on fibers and sometimes must be removed in order to perform dispersion microscopy. Weigh out a portion of the material and place it in a test tube. Add a sufficient amount of 0.1 M HCl or decalcifying solution in the tube to react all the carbonate as evidenced by gas formation; i.e., when the gas bubbles stop, add a little more solution. If no more gas forms, the reaction is complete. Filter the material out through a tared silver membrane, dry and weigh to determine the weight lost.

(d) Sample Preparation

Samples must be prepared so that accurate determination can be made of the asbestos type and amount present. The following steps are carried out in the low-flow hood (a low-flow hood has less than 50 fpm flow):

(i) If the sample has large lumps, is hard, or cannot be made to lie under a cover slip, the grain size must be reduced. Place a small amount between two slides and grind the material between them or grind a small amount in a clean mortar and pestle. The choice of whether to use an alumina, ruby, or diamond mortar depends on the hardness of the material. Impact damage can alter the asbestos mineral if too much mechanical shock occurs. (Freezer mills can completely destroy the observable crystallinity of asbestos and should not be used). For some samples, a portion of material can be shaved off with a scalpel, ground off with a hand grinder or hacksaw blade.

The preparation tools should either be disposable or cleaned thoroughly. Use vigorous scrubbing to loosen the fibers during the washing. Rinse the implements with copious amounts of water and air-dry in a dust-free environment.

(ii) If the sample is powder or has been reduced as in (i) above, it is ready to mount. Place a glass slide on a piece of optical tissue and write the identification on the painted or frosted end. Place two drops of index of refraction medium n = 1.550 on the slide. (The medium n = 1.550 is chosen because it is the matching index for chrysotile.) Dip the end of a clean paper-clip or dissecting needle into the droplet of refraction medium on the slide to moisten it. Then dip the probe into the powder sample. Transfer what sticks on the probe to the slide. The material on the end of the probe should have a diameter of about 3 mm for a good mount. If the material is very fine, less sample may be appropriate. For nonpowder samples such as fiber mats, forceps should be used to transfer a small amount of material to the slide. Stir the material in the medium on the slide, spreading it out and making the preparation as uniform as possible. Place a cover-slip on the preparation by gently lowering onto the slide and allowing it to fall “trapdoor

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fashion" on the preparation to push out any bubbles. Press gently on the cover slip to even out the distribution of particulate on the slide. If there is insufficient mounting oil on the slide, one or two drops may be placed near the edge of the coverslip on the slide. Capillary action will draw the necessary amount of liquid into the preparation. Remove excess oil with the point of a laboratory wiper.

Treat at least two different areas of each phase in this fashion. Choose representative areas of the sample. It may be useful to select particular areas or fibers for analysis. This is useful to identify asbestos in severely inhomogeneous samples.

When it is determined that amphiboles may be present, repeat the above process using the appropriate high-dispersion oils until an identification is made or all six asbestos minerals have been ruled out. Note that percent determination must be done in the index medium 1.550 because amphiboles tend to disappear in their matching mediums.

(e) Analytical procedure

Note: This method presumes some knowledge of mineralogy and optical petrography.

The analysis consists of three parts: The determination of whether there is asbestos present, what type is present and the determination of how much is present. The general flow of the analysis is:

(i) Gross examination.

(ii) Examination under polarized light on the stereo microscope.

(iii) Examination by phase-polar illumination on the compound phase microscope.

(iv) Determination of species by dispersion stain. Examination by Becke line analysis may also be used; however, this is usually more cumbersome for asbestos determination.

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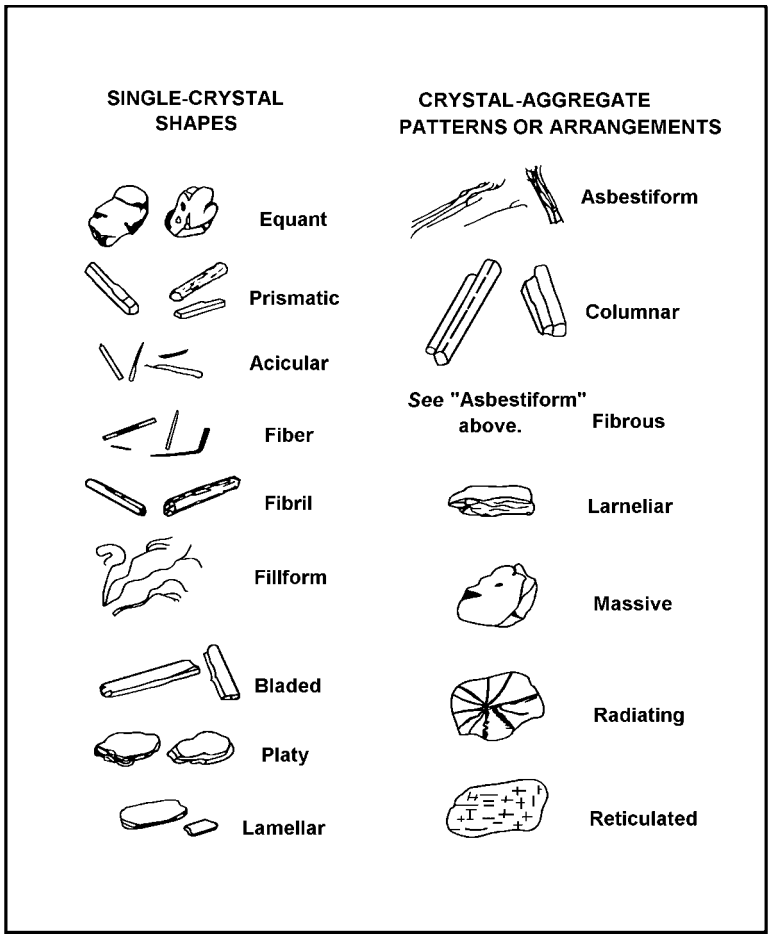

Figure 1. Particle definitions showing mineral growth habits. From the U.S. Bureau of Mines

(v) Difficult samples may need to be analyzed by SEM or TEM, or the results from those techniques combined with light microscopy for a definitive identification. Identification of a particle as asbestos requires that it be asbestiform. Description of particles should follow the suggestion of Campbell. (Figure 2)

For the purpose of regulation, the mineral must be one of the six minerals covered and must be in the asbestos growth habit. Large specimen samples of asbestos generally have the gross appearance of wood. Fibers are easily parted from it. Asbestos fibers are very long compared with their widths. The fibers have a very high tensile strength as demonstrated by bending without breaking. Asbestos fibers exist in bundles that are easily parted, show longitudinal fine structure and may be tufted at the ends showing "bundle of sticks morphology. In the microscope some of these properties may not be observable. Amphiboles do not always show striations along their length even when they are asbestos. Neither will they always show tufting. They generally do not show a curved nature except for very long fibers. Asbestos and asbestiform minerals are usually characterized in groups by extremely high aspect ratios (greater than 100:1). While aspect ratio analysis is useful for characterizing populations of fibers, it cannot be used to identify individual fibers of intermediate to short aspect ratio. Observation of many fibers is often necessary to determine whether a sample consists of "cleavage fragments" or of asbestos fibers.

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Most cleavage fragments of the asbestos minerals are easily distinguishable from true asbestos fibers. This is because true cleavage fragments usually have larger diameters than 1 micron. Internal structure of particles larger than this usually shows them to have no internal fibrillar structure. In addition, cleavage fragments of the monoclinic amphiboles show inclined extinction under crossed polars with no compensator. Asbestos fibers usually show extinction at zero degrees or ambiguous extinction if any at all. Morphologically, the larger cleavage fragments are obvious by their blunt or stepped ends showing prismatic habit. Also, they tend to be acicular rather than filiform.

Where the particles are less than 1 micron in diameter and have an aspect ratio greater than or equal to 3:1, it is recommended that the sample be analyzed by SEM or TEM if there is any question whether the fibers are cleavage fragments or asbestiform particles.

Care must be taken when analyzing by electron microscopy because the interferences are different from those in light microscopy and may structurally be very similar to asbestos. The classic interference is between anthophyllite and biopyribole or intermediate fiber. Use the same morphological clues for electron microscopy as are used for light microscopy, e.g. fibril splitting, internal longitudinal striation, fraying, curvature, etc.

(vi) Gross examination:

Examine the sample, preferably in the glass vial. Determine the presence of any obvious fibrous component. Estimate a percentage based on previous experience and current observation. Determine whether any pre-preparation is necessary. Determine the number of phases present. This step may be carried out or augmented by observation at 6x to 40x under a stereo microscope.

(vii) After performing any necessary pre-preparation, prepare slides of each phase as described above. Two preparations of the same phase in the same index medium can be made side-by-side on the same glass for convenience. Examine with the polarizing stereo microscope. Estimate the percentage of asbestos based on the amount of birefringent fiber present.

(viii) Examine the slides on the phase-polar microscopes at magnifications of 160x and 400x. Note the morphology of the fibers. Long, thin, very straight fibers with little curvature are indicative of fibers from the amphibole family. Curved, wavy fibers are usually indicative of chrysotile. Estimate the percentage of asbestos on the phase-polar microscope under conditions of crossed polars and a gypsum plate. Fibers smaller than 1.0 microns in thickness must be identified by inference to the presence of larger, identifiable fibers and morphology. If no larger fibers are visible, electron microscopy should be performed. At this point, only a tentative identification can be made. Full identification must be made with dispersion microscopy. Details of the tests are included in the appendices.

(ix) Once fibers have been determined to be present, they must be identified. Adjust the microscope for dispersion mode and observe the fibers. The microscope has a rotating stage, one polarizing element, and a system for generating dark-field dispersion microscopy (see subsection (4)(f) of this appendix). Align a fiber with its length parallel to the polarizer and note the color of the Becke lines. Rotate the stage to bring the fiber length perpendicular to the polarizer and note the color. Repeat this process for every fiber or fiber bundle examined. The colors must be consistent with the colors generated by standard asbestos reference materials for a positive identification. In n = 1.550, amphiboles will generally show a yellow to straw-yellow color indicating that the fiber indices of refraction are higher than the liquid. If long, thin fibers are noted and the

colors are yellow, prepare further slides as above in the suggested matching liquids listed below:

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Type of asbestos	Index of refraction
Chrysotile	n = 1.550.
Amosite	n = 1.670 or 1.680.
Crocidolite	n = 1.690.
Anthophyllite	n = 1.605 and 1.620.
Tremolite	n = 1.605 and 1.620.
Actinolite	n = 1.620.

Where more than one liquid is suggested, the first is preferred; however, in some cases this liquid will not give good dispersion color. Take care to avoid interferences in the other liquid; e.g., wollastonite in n = 1.620 will give the same colors as tremolite. In n = 1.605 wollastonite will appear yellow in all directions. Wollastonite may be determined under crossed polars as it will change from blue to yellow as it is rotated along its fiber axis by tapping on the cover slip. Asbestos minerals will not change in this way.

Determination of the angle of extinction may, when present, aid in the determination of anthophyllite from tremolite. True asbestos fibers usually have 0 degree extinction or ambiguous extinction, while cleavage fragments have more definite extinction.

Continue analysis until both preparations have been examined and all present species of asbestos are identified. If there are no fibers present, or there is less than 0.1% present, end the analysis with the minimum number of slides (2).

(x) Some fibers have a coating on them which makes dispersion microscopy very difficult or impossible. Becke line analysis or electron microscopy may be performed in those cases. Determine the percentage by light microscopy. TEM analysis tends to overestimate the actual percentage present.

(xi) Percentage determination is an estimate of occluded area, tempered by gross observation. Gross observation information is used to make sure that the high magnification microscopy does not greatly over- or under-estimate the amount of fiber present. This part of the analysis requires a great deal of experience. Satisfactory models for asbestos content analysis have not yet been developed, although some models based on metallurgical grain-size determination have found some utility. Estimation is more easily handled in situations where the grain sizes visible at about 160x are about the same and the sample is relatively homogeneous.

View all of the area under the cover slip to make the percentage determination. View the fields while moving the stage, paying attention to the clumps of material. These are not usually the best areas to perform dispersion microscopy because of the interference from other materials. But, they are the areas most likely to represent the accurate percentage in the sample. Small amounts of asbestos require slower scanning and more frequent analysis of individual fields.

Report the area occluded by asbestos as the concentration. This estimate does not generally take into consideration the difference in density of the different species present in the sample. For most samples this is adequate. Simulation studies with similar materials must be carried out to apply microvisual estimation for that purpose and is beyond the scope of this procedure.

(xii) Where successive concentrations have been made by chemical or physical means, the amount reported is the percentage of the material in the "as submitted" or original state. The percentage determined by microscopy is multiplied by the fractions remaining after pre-preparation steps to give the percentage in the original sample. For example:

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Step 1. 60% remains after heating at 550 degrees C for 1 h.

Step 2. 30% of the residue of step 1 remains after dissolution of carbonate in 0.1 m

HCl.

Step 3. Microvisual estimation determines that 5% of the sample is chrysotile asbestos.

The reported result is:

R = (Microvisual result in percent)x(Fraction remaining after step 2)x(Fraction remaining of original sample after step 1)

R = (5)x(.30)x(.60) = 0.9%

(xiii) Report the percent and type of asbestos present. For samples where asbestos was identified, but is less than 1.0%, report "Asbestos present, less than 1.0%." There must have been at least two observed fibers or fiber bundles in the two preparations to be reported as present. For samples where asbestos was not seen, report as "None Detected."

(4) **Auxiliary Information**

Because of the subjective nature of asbestos analysis, certain concepts and procedures need to be discussed in more depth. This information will help the analyst understand why some of the procedures are carried out the way they are.

(a) Light

Light is electromagnetic energy. It travels from its source in packets called quanta. It is instructive to consider light as a plane wave. The light has a direction of travel. Perpendicular to this and mutually perpendicular to each other, are two vector components. One is the magnetic vector and the other is the electric vector. We shall only be concerned with the electric vector. In this description, the interaction of the vector and the mineral will describe all the observable phenomena. From a light source such a microscope illuminator, light travels in all different direction from the filament.

In any given direction away from the filament, the electric vector is perpendicular to the direction of travel of a light ray. While perpendicular, its orientation is random about the travel axis. If the electric vectors from all the light rays were lined up by passing the light through a filter that would only let light rays with electric vectors oriented in one direction pass, the light would then be polarized.

Polarized light interacts with matter in the direction of the electric vector. This is the polarization direction. Using this property it is possible to use polarized light to probe different materials and identify them by how they interact with light. The speed of light in a vacuum is a constant at about 2.99þ108 m/s. When light travels in different materials such as air, water, minerals or oil, it does not travel at this speed. It travels slower. This slowing is a function of both the material through which the light is traveling and the wavelength or frequency of the light. In general, the more dense the material, the slower the light travels. Also, generally, the higher the frequency, the slower the light will travel. The ratio of the speed of light in a vacuum to that in a material is called the index of refraction (n). It is usually measured at 589 nm (the sodium D line). If white light (light containing all the visible wavelengths) travels through a material, rays of longer wavelengths will travel faster than those of shorter wavelengths, this separation is called dispersion. Dispersion is used as an identifier of materials as described in Section (4)(f).

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(b) Material Properties

Materials are either amorphous or crystalline. The difference between these two descriptions depends on the positions of the atoms in them. The atoms in amorphous materials are randomly arranged with no long range order. An example of an amorphous material is glass. The atoms in crystalline materials, on the other hand, are in regular arrays and have long range order. Most of the atoms can be found in highly predictable locations. Examples of crystalline material are salt, gold, and the asbestos minerals.

It is beyond the scope of this method to describe the different types of crystalline materials that can be found, or the full description of the classes into which they can fall. However, some general crystallography is provided below to give a foundation to the procedures described.

With the exception of anthophyllite, all the asbestos minerals belong to the monoclinic crystal type. The unit cell is the basic repeating unit of the crystal and for monoclinic crystals can be described as having three unequal sides, two 90 degrees angles and one angle not equal to 90 degrees. The orthorhombic group, of which anthophyllite is a member has three unequal sides and three 90 degrees angles. The unequal sides are a consequence of the complexity of fitting the different atoms into the unit cell. Although the atoms are in a regular array, that array is not symmetrical in all directions. There is long range order in the three major directions of the crystal. However, the order is different in each of the three directions. This has the effect that the index of refraction is different in each of the three directions. Using polarized light, we can investigate the index of refraction in each of the directions and identify the mineral or material under investigation. The indices alpha, beta, and gamma are used to identify the lowest, middle, and highest index of refraction respectively. The x direction, associated with alpha is called the fast axis. Conversely, the z direction is associated with gamma and is the slow direction. Crocidolite has alpha along the fiber length making it “length-fast.” The remainder of the asbestos minerals have the gamma axis along the fiber length. They are called “length-slow.” This orientation to fiber length is used to aid in the identification of asbestos.

(c) Polarized Light Technique

Polarized light microscopy as described in this section uses the phase-polar microscope described in Section (3)(b). A phase contrast microscope is fitted with two polarizing elements, one below and one above the sample. The polarizers have their polarization directions at right angles to each other. Depending on the tests performed, there may be a compensator between these two polarizing elements. Light emerging from a polarizing element has its electric vector pointing in the polarization direction of the element. The light will not be subsequently transmitted through a second element set at a right angle to the first element. Unless the light is altered as it passes from one element to the other, there is no transmission of light.

(d) Angle of Extinction

Crystals which have different crystal regularity in two or three main directions are said to be anisotropic. They have a different index of refraction in each of the main directions. When such a crystal is inserted between the crossed polars, the field of view is no longer dark but shows the crystal in color. The color depends on the properties of the crystal. The light acts as if it travels through the crystal along the optical axes. If a crystal optical axis were lined up along one of the polarizing directions (either the polarizer or the analyzer) the light would appear to travel only in that direction, and it would blink out or go dark. The difference in degrees between the fiber direction and the angle at which it blinks out is called the angle of extinction. When this angle can be measured, it is useful in identifying the mineral. The procedure for measuring the angle of extinction is to first identify the polarization direction in the microscope. A commercial alignment slide can be used to establish the polarization directions or use anthophyllite or another

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suitable mineral. This mineral has a zero degree angle of extinction and will go dark to extinction as it aligns with the polarization directions. When a fiber of anthophyllite has gone to extinction, align the eyepiece reticle or graticule with the fiber so that there is a visual cue as to the direction of polarization in the field of view. Tape or otherwise secure the eyepiece in this position so it will not shift.

After the polarization direction has been identified in the field of view, move the particle of interest to the center of the field of view and align it with the polarization direction. For fibers, align the fiber along this direction. Note the angular reading of the rotating stage. Looking at the particle, rotate the stage until the fiber goes dark or "blinks out." Again note the reading of the stage. The difference in the first reading and the second is an angle of extinction.

The angle measured may vary as the orientation of the fiber changes about its long axis. Tables of mineralogical data usually report the maximum angle of extinction. Asbestos forming minerals, when they exhibit an angle of extinction, usually do show an angle of extinction close to the reported maximum, or as appropriate depending on the substitution chemistry.

(e) Crossed Polars With Compensator

When the optical axes of a crystal are not lined up along one of the polarizing directions (either the polarizer or the analyzer) part of the light travels along one axis and part travels along the other visible axis. This is characteristic of birefringent materials.

The color depends on the difference of the two visible indices of refraction and the thickness of the crystal. The maximum difference available is the difference between the alpha and the gamma axises. This maximum difference is usually tabulated as the birefringence of the crystal.

For this test, align the fiber at 45 degrees to the polarization directions in order to maximize the contribution to each of the optical axes. The colors seen are called retardation colors. They arise from the recombination of light which has traveled through the two separate directions of the crystal. One of the rays is retarded behind the other since the light in that direction travels slower. On recombination, some of the colors which make up white light are enhanced by constructive interference and some are suppressed by destructive interference. The result is a color dependent on the difference between the indices and the thickness of the crystal. The proper colors, thicknesses, and retardations are shown on a Michel-Levy chart. The three items, retardation, thickness and birefringence are related by the following relationship: Lambda

$$R = t(n\gamma - \alpha)$$

R = retardation,
t = crystal thickness in micron, and
alpha, gamma = indices of refraction.

Examination of the equation for asbestos minerals reveals that the visible colors for almost all common asbestos minerals and fiber sizes are shades of gray and black. The eye is relatively poor at discriminating different shades of gray. It is very good at discriminating different colors. In order to compensate for the low retardation, a compensator is added to the light train between the polarization elements. The compensator used for this test is a gypsum plate of known thickness and birefringence. Such a compensator when oriented at 45 degrees to the polarizer direction, provides a retardation of 530 nm of the 530 nm wavelength color. This enhances the red color and gives the background a characteristic red to red-magenta color. If this "full-wave" compensator is in place when the asbestos preparation is inserted into the light train, the colors

seen on the fibers are quite different. Gypsum, like asbestos has a fast axis and a slow axis. When

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a fiber is aligned with its fast axis in the same direction as the fast axis of the gypsum plate, the ray vibrating in the slow direction is retarded by both the asbestos and the gypsum. This results in a higher retardation than would be present for either of the two minerals. The color seen is a second order blue. When the fiber is rotated 90 degrees using the rotating stage, the slow direction of the fiber is now aligned with the fast direction of the gypsum and the fast direction of the fiber is aligned with the slow direction of the gypsum. Thus, one ray vibrates faster in the fast direction of the gypsum, and slower in the slow direction of the fiber; the other ray will vibrate slower in the slow direction of the gypsum and faster in the fast direction of the fiber. In this case, the effect is subtractive and the color seen is a first order yellow. As long as the fiber thickness does not add appreciably to the color, the same basic colors will be seen for all asbestos types except crocidolite. In crocidolite the colors will be weaker, may be in the opposite directions, and will be altered by the blue absorption color natural to crocidolite. Hundreds of other materials will give the same colors as asbestos, and therefore, this test is not definitive for asbestos. The test is useful in discriminating against fiberglass or other amorphous fibers such as some synthetic fibers. Certain synthetic fibers will show retardation colors different than asbestos; however, there are some forms of polyethylene and aramid which will show morphology and retardation colors similar to asbestos minerals. This test must be supplemented with a positive identification test when birefringent fibers are present which can not be excluded by morphology. This test is relatively ineffective for use on fibers less than 1 micron in diameter. For positive confirmation TEM or SEM should be used if no larger bundles or fibers are visible.

(f) Dispersion Staining

Dispersion microscopy or dispersion staining is the method of choice for the identification of asbestos in bulk materials. Becke line analysis is used by some laboratories and yields the same results as does dispersion staining for asbestos and can be used in lieu of dispersion staining. Dispersion staining is performed on the same platform as the phase-polar analysis with the analyzer and compensator removed. One polarizing element remains to define the direction of the light so that the different indices of refraction of the fibers may be separately determined. Dispersion microscopy is a dark-field technique when used for asbestos. Particles are imaged with scattered light. Light which is unscattered is blocked from reaching the eye either by the back field image mask in a McCrone objective or a back field image mask in the phase condenser. The most convenient method is to use the rotating phase condenser to move an oversized phase ring into place.

The ideal size for this ring is for the central disk to be just larger than the objective entry aperture as viewed in the back focal plane. The larger the disk, the less scattered light reaches the eye. This will have the effect of diminishing the intensity of dispersion color and will shift the actual color seen. The colors seen vary even on microscopes from the same manufacturer. This is due to the different bands of wavelength exclusion by different mask sizes. The mask may either reside in the condenser or in the objective back focal plane. It is imperative that the analyst determine by experimentation with asbestos standards what the appropriate colors should be for each asbestos type. The colors depend also on the temperature of the preparation and the exact chemistry of the asbestos. Therefore, some slight differences from the standards should be allowed. This is not a serious problem for commercial asbestos uses. This technique is used for identification of the indices of refraction for fibers by recognition of color. There is no direct numerical readout of the index of refraction. Correlation of color to actual index of refraction is possible by referral to published conversion tables. This is not necessary for the analysis of asbestos. Recognition of appropriate colors along with the proper morphology are deemed sufficient to identify the commercial asbestos minerals. Other techniques including SEM, TEM, and XRD may be required to provide additional information in order to identify other types of asbestos.

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Make a preparation in the suspected matching high dispersion oil, e.g., n = 1.550 for chrysotile. Perform the preliminary tests to determine whether the fibers are birefringent or not. Take note of the morphological character. Wavy fibers are indicative of chrysotile while long, straight, thin, frayed fibers are indicative of amphibole asbestos. This can aid in the selection of the appropriate matching oil. The microscope is set up and the polarization direction is noted as in Section (4)(d). Align a fiber with the polarization direction. Note the color. This is the color parallel to the polarizer. Then rotate the fiber rotating the stage 90 degrees so that the polarization direction is across the fiber. This is the perpendicular position. Again note the color. Both colors must be consistent with standard asbestos minerals in the correct direction for a positive identification of asbestos. If only one of the colors is correct while the other is not, the identification is not positive. If the colors in both directions are bluish-white, the analyst has chosen a matching index oil which is higher than the correct matching oil, e.g. the analyst has used n = 1.620 where chrysotile is present. The next lower oil (Section (3)(e)) should be used to prepare another specimen. If the color in both directions is yellow-white to straw-yellow-white, this indicates that the index of the oil is lower than the index of the fiber, e.g. the preparation is in n = 1.550 while anthophyllite is present. Select the next higher oil (Section (3)(e)) and prepare another slide. Continue in this fashion until a positive identification of all asbestos species present has been made or all possible asbestos species have been ruled out by negative results in this test. Certain plant fibers can have similar dispersion colors as asbestos. Take care to note and evaluate the morphology of the fibers or remove the plant fibers in pre-preparation. Coating material on the fibers such as carbonate or vinyl may destroy the dispersion color. Usually, there will be some outcropping of fiber which will show the colors sufficient for identification. When this is not the case, treat the sample as described in Section (3)(c) and then perform dispersion staining. Some samples will yield to Becke line analysis if they are coated or electron microscopy can be used for identification.

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[Statutory Authority: RCW 49.17.040, [49.17.]050 and [49.17.]060. 97-01-079, 296-62-07753, filed 12/17/96, effective 3/1/97. Statutory Authority: Chapter 49.17 RCW. 89-21-018 (Order 89-10), 296-62-07753, filed 10/10/89, effective 11/24/89; 87-24-051 (Order 87-24), 296-62-07753, filed 11/30/87.]

WAC 296-62-07755 Appendix K--Smoking cessation program information for asbestos, tremolite, anthophyllite, and actinolite--Nonmandatory. The following organizations provide smoking cessation information and program material:

(1) The National Cancer Institute operates a toll-free Cancer Information Service (CIS) with trained personnel to help you. Call 1-800-4-CANCER* to reach the CIS office serving your area, or write: Office of Cancer Communications, National Cancer Institute, National Institutes of Health, Building 31, Room 10A24, Bethesda, Maryland 20892.

(2) American Cancer Society, 3340 Peachtree Road, N.E., Atlanta, Georgia 30062, (404) 320-3333. The American Cancer Society (ACS) is a voluntary organization composed of 58 divisions and 3,100 local units. Through "The Great American Smokeout" in November, the annual Cancer Crusade in April, and numerous educational materials, ACS helps people learn about the health hazards of smoking and become successful ex-smokers.

(3) American Heart Association, 7320 Greenville Avenue, Dallas, Texas 75231, (214) 750-5300. The American Heart Association (AHA) is a voluntary organization with 130,000 members (physicians, scientists, and laypersons) in 55 states and regional groups. AHA produces a variety of publications and audiovisual materials about the effects of smoking on the heart. AHA also has developed a guidebook for incorporating a weight-control component into smoking cessation programs.

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(4) American Lung Association, 1740 Broadway, New York, New York 10019, (212) 245-8000. A voluntary organization of 7,500 members (physicians, nurses, and laypersons), the American Lung Association (ALA) conducts numerous public information programs about the health effect of smoking. ALA has 59 state and 85 local units. The organization actively supports legislation and information campaigns for nonsmokers' rights and provides help for smokers who want to quit, for example, through "Freedom From Smoking," a self-help smoking cessation program.

(5) Office on Smoking and Health, United States Department of Health and Human Services, 5600 Fishers Lane, Park Building, Room 110, Rockville, Maryland 20857. The Office on Smoking and Health (OSH) is the Department of Health and Human Services' lead agency in smoking control. OSH has sponsored distribution of publications on smoking-related topics, such as free flyers on relapse after initial quitting, helping a friend or family member quit smoking, the health hazards of smoking, and the effects of parental smoking on teenagers.

*In Hawaii, on Oahu call 524-1234 (call collect from neighboring islands), Spanish-speaking staff members are available during daytime hours to callers from the following areas: California, Florida, Georgia, Illinois, New Jersey (area code 210), New York, and Texas. Consult your local telephone directory for listings of local chapters.

[Statutory Authority: Chapter 49.17 RCW. 91-03-044 (Order 90-18), 296-62-07755, filed 1/10/91, effective 2/12/91.]

PART J
BIOLOGICAL AGENTS

WAC 296-62-080 Biological agents.

(1) **Definition.** Biological agents are organisms or their by-products.

(2) **Protection from exposure.** Workmen shall be protected from exposure to hazardous concentrations of biological agents which may arise from processing, handling or using materials or waste.

[Order 73-3, 296-62-080, filed 5/7/73; Order 70-8, 296-62-080, filed 7/31/70, effective 9/1/70; Rule 8.010, effective 8/1/63.]

WAC 296-62-08001 Bloodborne pathogens.

(1) **Scope and application.** This section applies to all occupational exposure to blood or other potentially infectious materials as defined by subsection (2) of this section.

(2) **Definitions.** For purposes of this section, the following shall apply:

"Blood" means human blood, human blood components, and products made from human blood.

"Bloodborne pathogens" means pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

"Clinical laboratory" means a workplace where diagnostic or other screening procedures are performed on blood or other potentially infectious materials.

"Contaminated" means the presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

"Contaminated laundry" means laundry which has been soiled with blood or other potentially infectious materials or may contain contaminated sharps.

"Contaminated sharps" means any contaminated object that can penetrate the skin including, but not limited to, needles, scalpels, broken glass, broken capillary tubes, and exposed ends of dental wires.

"Decontamination" means the use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use, or disposal.

"Director" means the director of the Washington state department of labor and industries; the state designee for the Washington state plan.

"Engineering controls" means controls (e.g., sharps disposal containers, self-sheathing needles, safer medical devices, such as sharps with engineered sharps injury protections and needleless systems) that isolate or remove the bloodborne pathogens hazard from the workplace.

"Exposure incident" means a specific eye, mouth, other mucous membrane, nonintact skin, or parenteral contact with blood or other potentially infectious materials that results from the performance of an employee's duties.

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"Handwashing facilities" means a facility providing an adequate supply of running potable water, soap and single use towels or hot air drying machines.

"Licensed healthcare professional" is a person whose legally permitted scope of practice allows him or her to independently perform the activities required by subsection (6) of this section, entitled Hepatitis B vaccination and post-exposure evaluation and follow-up.

"HBV" means hepatitis B virus.

"HIV" means human immunodeficiency virus.

"Neddleless systems" means a device that does not use needles for:

- The collection of bodily fluids or withdrawal of body fluids after initial venous or arterial access is established;
- The administration of medication or fluids; or
- Any other procedure involving the potential for occupational exposure to bloodborne pathogens due to precutaneous injuries from contaminated sharps.

"Occupational exposure" means reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties.

"Other potentially infectious materials" means:

(a) The following human body fluids: Semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, saliva in dental procedures, any body fluid that is visibly contaminated with blood, and all body fluids in situations where it is difficult or impossible to differentiate between body fluids;

(b) Any unfixed tissue or organ (other than intact skin) from a human (living or dead); and

(c) HIV-containing cell or tissue cultures, organ cultures, and HIV- or HBV-containing culture medium or other solutions; and blood, organs, or other tissues from experimental animals infected with HIV or HBV.

"Parenteral" means piercing mucous membranes or the skin barrier through such events as needlesticks, human bites, cuts, and abrasions.

"Personal protective equipment" is specialized clothing or equipment worn by an employee for protection against a hazard. General work clothes (e.g., uniforms, pants, shirts, or blouses) not intended to function as protection against a hazard are not considered to be personal protective equipment.

"Production facility" means a facility engaged in industrial-scale, large-volume or high concentration production of HIV or HBV.

"Regulated waste" means liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials.

"Research laboratory" means a laboratory producing or using research-laboratory-scale amounts of HIV or HBV. Research laboratories may produce high concentrations of HIV or HBV but not in the volume found in production facilities.

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"Sharps with engineered sharps injury protections" means a nonneedle sharp or a needle device used for withdrawing body fluids, accessing a vein or artery, or administering medications or other fluids, with a built-in safety feature or mechanism that effectively reduces the risk of an exposure incident.

"Source individual" means any individual, living or dead, whose blood or other potentially infectious materials may be a source of occupational exposure to the employee. Examples include, but are not limited to, hospital and clinic patients; clients in institutions for the developmentally disabled; trauma victims; clients of drug and alcohol treatment facilities; residents of hospices and nursing homes; human remains; and individuals who donate or sell blood or blood components.

"Sterilize" means the use of a physical or chemical procedure to destroy all microbial life including highly resistant bacterial endospores.

"Universal precautions" are an approach to infection control. According to the concept of universal precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens.

"Work practice controls" means controls that reduce the likelihood of exposure by altering the manner in which a task is performed (e.g., prohibiting recapping of needles by a two-handed technique).

(3) **Exposure control.**

(a) Exposure control plan.

(i) Each employer having an employee(s) with occupational exposure as defined by subsection (2) of this section shall establish a written exposure control plan designed to eliminate or minimize employee exposure.

(ii) The exposure control plan shall contain at least the following elements:

(A) The exposure determination required by (b) of this subsection;

(B) The schedule and method of implementation for subsection (4) of this section, Methods of compliance; subsection (5) of this section, HIV and HBV research laboratories and production facilities; subsection (6) of this section, Hepatitis B vaccination and post-exposure evaluation and follow-up; subsection (7) of this section, Communication of hazards to employees; and subsection (8) of this section, Recordkeeping; and

(C) The procedure for the evaluation of circumstances surrounding exposure incidents as required by subsection (6)(c)(i) of this section.

(iii) Each employer shall ensure that a copy of the exposure control plan is accessible to employees in accordance with WAC 296-62-05209.

(iv) The exposure control plan shall be reviewed and updated at least annually, and whenever necessary to reflect new or modified tasks and procedures which affect occupational exposure, and to reflect new or revised employee positions with occupational exposure. The review and update of such plans shall also:

(A) Reflect changes in technology that eliminate or reduce exposure to bloodborne pathogens; and

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(B) Document annually consideration and implementation of appropriate commercially available and effective safer medical devices designed to eliminate or minimize occupational exposure.

(v) An employer, who is required to establish and exposure control plan shall solicit input from nonmanagerial employees responsible for direct patient care who are potentially exposed to injuries from contaminated sharps in the identification, evaluation, and selection of effective engineering and work practice controls and shall document the solicitation in the exposure control plan.

(b) Exposure determination.

(i) Each employer who has an employee(s) with occupational exposure as defined by subsection (2) of this section shall prepare an exposure determination. This exposure determination shall contain the following:

(A) A list of all job classifications in which all employees in those job classifications have occupational exposure;

(B) A list of job classifications in which some employees have occupational exposure; and

(C) A list of all tasks and procedures or groups of closely related tasks and procedures in which occupational exposure occurs, and that are preformed by employees in job classifications listed in accordance with the provisions of (b)(i)(B) of this subsection.

(ii) This exposure determination shall be made without regard to the use of personal protective equipment.

(4) **Methods of compliance.**

(a) General. Universal precautions shall be observed to prevent contact with blood or other potentially infectious materials. Under circumstances in which differentiation between body fluid types is difficult or impossible, all body fluids shall be considered potentially infectious materials.

(b) Engineering and work practice controls.

(i) Engineering and work practice controls shall be used to eliminate or minimize employee exposure. Where occupational exposure remains after institution of these controls, personal protective equipment shall also be used.

(ii) Engineering controls shall be examined and maintained or replaced on a regular schedule to ensure their effectiveness.

(iii) Employers shall provide handwashing facilities which are readily accessible to employees.

(iv) When provision of handwashing facilities is not feasible, the employer shall provide either an appropriate antiseptic hand cleanser in conjunction with clean cloth/paper towels or antiseptic towelettes. When antiseptic hand cleansers or towelettes are used, hands shall be washed with soap and running water as soon as feasible.

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(v) Employers shall ensure that employees wash their hands immediately or as soon as feasible after removal of gloves or other personal protective equipment.

(vi) Employers shall ensure that employees wash hands and any other skin with soap and water, or flush mucous membranes with water immediately or as soon as feasible following contact of such body areas with blood or other potentially infectious materials.

(vii) Contaminated needles and other contaminated sharps shall not be bent, recapped, or removed except as noted in (b)(vii)(A) and (B) of this subsection. Shearing or breaking of contaminated needles is prohibited.

(A) Contaminated needles and other contaminated sharps shall not be bent, recapped or removed unless the employer can demonstrate that no alternative is feasible or that such action is required by a specific medical or dental procedure.

(B) Such bending, recapping or needle removal must be accomplished through the use of a mechanical device or a one-handed technique.

(viii) Immediately or as soon as possible after use, contaminated reusable sharps shall be placed in appropriate containers until properly reprocessed. These containers shall be:

(A) Puncture resistant;

(B) Labeled or color-coded in accordance with this standard;

(C) Leakproof on the sides and bottom; and

(D) In accordance with the requirements set forth in (d)(ii)(E) of this subsection for reusable sharps.

(ix) Eating, drinking, smoking, applying cosmetics, or lip balm, and handling contact lenses are prohibited in work areas where there is a reasonable likelihood of occupational exposure.

(x) Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets, or on countertops or benchtops where blood or other potentially infectious materials are present.

(xi) All procedures involving blood or other potentially infectious materials shall be performed in such a manner as to minimize splashing, spraying, spattering, and generation of droplets of these substances.

(xii) Mouth pipetting/suctioning of blood or other potentially infectious materials is prohibited.

(xiii) Specimens of blood or other potentially infectious materials shall be placed in a container which prevents leakage during collection, handling, processing, storage, transport, or shipping.

(A) The container for storage, transport, or shipping shall be labeled or color-coded according to subsection (7)(a)(i) of this section and closed prior to being stored, transported, or shipped. When a facility utilizes universal precautions in the handling of all specimens, the labeling/color-coding of specimens is not

necessary provided containers are recognizable as containing specimens. This exemption only applies while such specimens/containers remain within the facility. Labeling or color-coding in accordance with subsection (7)(a)(i) of this section is required when such specimens/containers leave the facility.

(B) If outside contamination of the primary container occurs, the primary container shall be placed within a second container which prevents leakage during handling, processing, storage, transport, or shipping and is labeled or color-coded according to the requirements of this standard.

(C) If the specimen could puncture the primary container, the primary container shall be placed within a secondary container which is punctured-resistant in addition to the above characteristics.

(xiv) Equipment which may become contaminated with blood or other potentially infectious materials shall be examined prior to servicing or shipping and shall be decontaminated as necessary, unless the employer can demonstrate that decontamination of such equipment or portions of such equipment is not feasible.

(A) A readily observable label in accordance with subsection (7)(a)(i)(H) of this section shall be attached to the equipment stating which portions remain contaminated.

(B) The employer shall ensure that this information is conveyed to all affected employees, the servicing representative, and/or the manufacturer, as appropriate, prior to handling, servicing, or shipping so that appropriate precautions will be taken.

(c) Personal protective equipment.

(i) Provision. When there is occupational exposure, the employer shall provide, at no cost to the employee, appropriate personal protective equipment such as, but not limited to, gloves, gowns, laboratory coats, face shields or masks and eye protection, and mouthpieces, resuscitation bags, pocket masks, or other ventilation devices. Personal protective equipment will be considered “appropriate” only if it does not permit blood or other potentially infectious materials to pass through to or reach the employee's work clothes, street clothes, undergarments, skin, eyes, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the protective equipment will be used.

(ii) Use. The employer shall ensure that the employee uses appropriate personal protective equipment unless the employer shows that the employee temporarily and briefly declined to use personal protective equipment when, under rare and extraordinary circumstances, it was the employee's professional judgment that in the specific instance its use would have prevented the delivery of health care or public safety services or would have posed an increased hazard to the safety of the worker or the co-worker. When the employee makes this judgment, the circumstances shall be investigated and documented in order to determine whether changes can be instituted to prevent such occurrences in the future.

(iii) Accessibility. The employer shall ensure that appropriate personal protective equipment in the appropriate sizes is readily accessible at the worksite or is issued to employees. Hypoallergenic gloves, glove liners, powderless gloves, or other similar alternatives shall be readily accessible to those employees who are allergic to the gloves normally provided.

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(iv) Cleaning, laundering, and disposal. The employer shall clean, launder, and dispose of personal protective equipment required by subsections (4) and (5) of this section, at no cost to the employee.

(v) Repair and replacement. The employer shall repair or replace personal protective equipment as needed to maintain its effectiveness, at no cost to the employee.

(vi) If a garment(s) is penetrated by blood or other potentially infectious materials, the garment(s) shall be removed immediately or as soon as feasible.

(vii) All personal protective equipment shall be removed prior to leaving the work area.

(viii) When personal protective equipment is removed it shall be placed in an appropriately designated area or container for storage, washing, decontamination, or disposal.

(ix) Gloves. Gloves shall be worn when it can be reasonably anticipated that the employee may have hand contact with blood, other potentially infectious materials, mucous membranes, and nonintact skin; when performing vascular access procedures except as specified in (c)(ix)(D) of this subsection; and when handling or touching contaminated items or surfaces.

(A) Disposable (single use) gloves such as surgical or examination gloves, shall be replaced as soon as practical when contaminated or as soon as feasible if they are torn, punctured, or when their ability to function as a barrier is compromised.

(B) Disposable (single use) gloves shall not be washed or decontaminated for re-use.

(C) Utility gloves may be decontaminated for re-use if the integrity of the glove is not compromised. However, they must be discarded if they are cracked, peeling, torn, punctured, or exhibit other signs of deterioration or when their ability to function as a barrier is compromised.

(D) If an employer in a volunteer blood donation center judges that routine gloving for all phlebotomies is not necessary then the employer shall:

(I) Periodically reevaluate this policy;

(II) Make gloves available to all employees who wish to use them for phlebotomy;

(III) Not discourage the use of gloves for phlebotomy; and

(IV) Require that gloves be used for phlebotomy in the following circumstances:

(aa) When the employee has cuts, scratches, or other breaks in his or her skin;

(bb) When the employee judges that hand contamination with blood may occur, for example, when performing phlebotomy on an uncooperative source individual; and

(cc) When the employee is receiving training in phlebotomy.

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(x) Masks, eye protection, and face shields. Masks in combination with eye protection devices, such as goggles or glasses with solid side shields, or chin-length face shields, shall be worn whenever splashes, spray, spatter, or droplets of blood or other potentially infectious materials may be generated and eye, nose, or mouth contamination can be reasonably anticipated.

(xi) Gowns, aprons, and other protective body clothing. Appropriate protective clothing such as, but not limited to, gowns, aprons, lab coats, clinic jackets, or similar outer garments shall be worn in occupational exposure situations. The type and characteristics will depend upon the task and degree of exposure anticipated.

(xii) Surgical caps or hoods and/or shoe covers or boots shall be worn in instances when gross contamination can reasonably be anticipated (e.g., autopsies, orthopaedic surgery).

(d) Housekeeping.

(i) General. Employers shall ensure that the worksite is maintained in a clean and sanitary condition. The employer shall determine and implement an appropriate written schedule for cleaning and method of decontamination based upon the location within the facility, type of surface to be cleaned, type of soil present, and tasks or procedures being performed in the area.

(ii) All equipment and environmental and working surfaces shall be cleaned and decontaminated after contact with blood or other potentially infectious materials.

(A) Contaminated work surfaces shall be decontaminated with an appropriate disinfectant after completion of procedures; immediately or as soon as feasible when surfaces are overtly contaminated or after any spill of blood or other potentially infectious materials; and at the end of the workshift if the surface may have become contaminated since the last cleaning.

(B) Protective coverings, such as plastic wrap, aluminum foil, or imperviously-backed absorbent paper used to cover equipment and environmental surfaces, shall be removed and replaced as soon as feasible when they become overtly contaminated or at the end of the workshift if they may have become contaminated during the shift.

(C) All bins, pails, cans, and similar receptacles intended for reuse which have a reasonable likelihood for becoming contaminated with blood or other potentially infectious materials shall be inspected and decontaminated on a regularly scheduled basis and cleaned and decontaminated immediately or as soon as feasible upon visible contamination.

(D) Broken glassware which may be contaminated shall not be picked up directly with the hands. It shall be cleaned up using mechanical means, such as a brush and dust pan, tongs, or forceps.

(E) Reusable sharps that are contaminated with blood or other potentially infectious materials shall not be stored or processed in a manner that requires employees to reach by hand into the containers where these sharps have been placed.

(iii) Regulated waste.

(A) Contaminated sharps discarding and containment.

WAC 296-62-08001 (Cont.)

(I) Contaminated sharps shall be discarded immediately or as soon as feasible in containers that are:

(aa) Closable;

(bb) Puncture resistant;

(cc) Leakproof on sides and bottom; and

(dd) abeled or color-coded in accordance with subsection (7)(a)(i) of this section.

(II) During use, containers for contaminated sharps shall be:

(aa) Easily accessible to personnel and located as close as is feasible to the immediate area where sharps are used or can be reasonably anticipated to be found (e.g., laundries);

(bb) Maintained upright throughout use; and

(cc) Replaced routinely and not be allowed to overfill.

(III) When moving containers of contaminated sharps from the area of use, the containers shall be:

(aa) Closed immediately prior to removal or replacement to prevent spillage or protrusion of contents during handling, storage, transport, or shipping;

(bb) Placed in a secondary container if leakage is possible. The second container shall be:

(AA) Closable;

(BB) Constructed to contain all contents and prevent leakage during handling, storage, transport, or shipping; and

(CC) Labeled or color-coded according to subsection (7)(a)(i) of this section.

(IV) Reusable containers shall not be opened, emptied, or cleaned manually or in any other manner which would expose employees to the risk of percutaneous injury.

(B) Other regulated waste containment.

(I) Regulated waste shall be placed in containers which are:

(aa) Closable;

(bb) Constructed to contain all contents and prevent leakage of fluids during handling, storage, transport, or shipping;

(cc) Labeled or color-coded in accordance with subsection (7)(a)(i) of this section; and

(dd) Closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport, or shipping.

(II) If outside contamination of the regulated waste container occurs, it shall be placed in a second container. The second container shall be:

(aa) Closable;

(bb) Constructed to contain all contents and prevent leakage of fluids during handling, storage, transport, or shipping;

(cc) Labeled or color-coded in accordance with subsection (7)(a)(i) of this section; and

(dd) Closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport, or shipping.

(C) Disposal of all regulated waste shall be in accordance with applicable regulations of the United States, states and territories, and political subdivisions of states and territories.

(iv) Laundry.

(A) Contaminated laundry shall be handled as little as possible with a minimum of agitation.

(I) Contaminated laundry shall be bagged or containerized at the location where it was used and shall not be sorted or rinsed in the location of use.

(II) Contaminated laundry shall be placed and transported in bags or containers labeled or color-coded in accordance with subsection (7)(a)(i) of this section. When a facility utilizes universal precautions in the handling of all soiled laundry, alternative labeling or color-coding is sufficient if it permits all employees to recognize the containers as requiring compliance with universal precautions.

(III) Whenever contaminated laundry is wet and presents a reasonable likelihood of soak-through of or leakage from the bag or container, the laundry shall be placed and transported in bags or containers which prevent soak-through and/or leakage of fluids to the exterior.

(B) The employer shall ensure that employees who have contact with contaminated laundry wear protective gloves and other appropriate personal protective equipment.

(C) When a facility ships contaminated laundry off-site to a second facility which does not utilize universal precautions in the handling of all laundry, the facility generating the contaminated laundry must place such laundry in bags or containers which are labeled or color-coded in accordance with subsection (7)(a)(i) of this section.

WAC 296-62-08001 (Cont.)

(5) **HIV and HBV research laboratories and production facilities.**

(a) This subsection applies to research laboratories and production facilities engaged in the culture, production, concentration, experimentation, and manipulation of HIV and HBV. It does not apply to clinical or diagnostic laboratories engaged solely in the analysis of blood, tissues, or organs. These requirements apply in addition to the other requirements of the standard.

(b) Research laboratories and production facilities shall meet the following criteria:

(i) Standard microbiological practices. All regulated waste shall either be incinerated or decontaminated by a method such as autoclaving known to effectively destroy bloodborne pathogens.

(ii) Special practices.

(A) Laboratory doors shall be kept closed when work involving HIV or HBV is in progress.

(B) Contaminated materials that are to be decontaminated at a site away from the work area shall be placed in a durable, leakproof, labeled, or color-coded container that is closed before being removed from the work area.

(C) Access to the work area shall be limited to authorized persons. Written policies and procedures shall be established whereby only persons who have been advised of the potential biohazard, who meet any specific entry requirements, and who comply with all entry and exit procedures shall be allowed to enter the work areas and animal rooms.

(D) When other potentially infectious materials or infected animals are present in the work area or containment module, a hazard warning sign incorporating the universal biohazard symbol shall be posted on all access doors. The hazard warning sign shall comply with subsection (7)(a)(ii) of this section.

(E) All activities involving other potentially infectious materials shall be conducted in biological safety cabinets or other physical-containment devices within the containment module. No work with these other potentially infectious materials shall be conducted on the open bench.

(F) Laboratory coats, gowns, smocks, uniforms, or other appropriate protective clothing shall be used in the work area and animal rooms. Protective clothing shall not be worn outside of the work area and shall be decontaminated before being laundered.

(G) Special care shall be taken to avoid skin contact with other potentially infectious materials. Gloves shall be worn when handling infected animals and when making hand contact with other potentially infectious materials is unavoidable.

(H) Before disposal all waste from work areas and from animal rooms shall either be incinerated or decontaminated by a method such as autoclaving known to effectively destroy bloodborne pathogens.

WAC 296-62-08001 (Cont.)

(I) Vacuum lines shall be protected with liquid disinfectant traps and high-efficiency particulate air (HEPA) filters or filters of equivalent or superior efficiency and which are checked routinely and maintained or replaced as necessary.

(J) Hypodermic needles and syringes shall be used only for parenteral injection and aspiration of fluids from laboratory animals and diaphragm bottles. Only needle-locking syringes or disposable syringe-needle units (i.e., the needle is integral to the syringe) shall be used for the injection or aspiration of other potentially infectious materials. Extreme caution shall be used when handling needles and syringes. A needle shall not be bent, sheared, replaced in the sheath or guard, or removed from the syringe following use. The needle and syringe shall be promptly placed in a puncture-resistant container and autoclaved or decontaminated before reuse or disposal.

(K) All spills shall be immediately contained and cleaned up by appropriate professional staff or others properly trained and equipped to work with potentially concentrated infectious materials.

(L) A spill or accident that results in an exposure incident shall be immediately reported to the laboratory director or other responsible person.

(M) A biosafety manual shall be prepared or adopted and periodically reviewed and updated at least annually or more often if necessary. Personnel shall be advised of potential hazards, shall be required to read instructions on practices and procedures, and shall be required to follow them.

(iii) Containment equipment.

(A) Certified biological safety cabinets (Class I, II, or III) or other appropriate combinations of personal protection or physical containment devices, such as special protective clothing, respirators, centrifuge safety cups, sealed centrifuge rotors, and containment caging for animals, shall be used for all activities with other potentially infectious materials that pose a threat of exposure to droplets, splashes, spills, or aerosols.

(B) Biological safety cabinets shall be certified when installed, whenever they are moved and at least annually.

(c) HIV and HBV research laboratories shall meet the following criteria:

(i) Each laboratory shall contain a facility for hand washing and an eyewash facility which is readily available within the work area.

(ii) An autoclave for decontamination of regulated waste shall be available.

(d) HIV and HBV production facilities shall meet the following criteria:

(i) The work areas shall be separated from areas that are open to unrestricted traffic flow within the building. Passage through two sets of doors shall be the basic requirement for entry into the work area from access corridors or other contiguous areas. Physical separation of the high-containment work area from access corridors or other areas or activities may also be provided by a double-doored clothes-change room (showers may be included), airlock, or other access facility that requires passing through two sets of doors before entering the work area.

(ii) The surfaces of doors, walls, floors, and ceilings in the work area shall be water resistant so that they can be easily cleaned. Penetrations in these surfaces shall be sealed or capable of being sealed to facilitate decontamination.

(iii) Each work area shall contain a sink for washing hands and a readily available eye wash facility. The sink shall be foot, elbow, or automatically operated and shall be located near the exit door of the work area.

(iv) Access doors to the work area or containment module shall be self-closing.

(v) An autoclave for decontamination of regulated waste shall be available within or as near as possible to the work area.

(vi) A ducted exhaust-air ventilation system shall be provided. This system shall create directional airflow that draws air into the work area through the entry area. The exhaust air shall not be recirculated to any other area of the building, shall be discharged to the outside, and shall be dispersed away from occupied areas and air intakes. The proper direction of the airflow shall be verified (i.e., into the work area).

(e) Training requirements. Additional training requirements for employees in HIV and HBV research laboratories and HIV and HBV production facilities are specified in subsection (7)(b)(ix) of this section.

(6) **Hepatitis B vaccination and post-exposure evaluation and follow-up.**

(a) General.

(i) The employer shall make available the hepatitis B vaccine and vaccination series to all employees who have occupational exposure, and post-exposure evaluation and follow-up to all employees who have had an exposure incident.

(ii) The employer shall ensure that all medical evaluations and procedures including the hepatitis B vaccine and vaccination series and post-exposure evaluation and follow-up, including prophylaxis, are:

(A) Made available at no cost to the employee;

(B) Made available to the employee at a reasonable time and place;

(C) Performed by or under the supervision of a licensed physician or by or under the supervision of another licensed healthcare professional; and

(D) Provided according to recommendations of the United States Public Health Service current at the time these evaluations and procedures take place, except as specified by this subsection (6).

(iii) The employer shall ensure that all laboratory tests are conducted by an accredited laboratory at no cost to the employee.

(b) Hepatitis B vaccination.

(i) Hepatitis B vaccination shall be made available after the employee has received the training required in subsection (7)(b)(vii)(I) of this section and within ten working days of initial assignment to all employees who have occupational exposure unless the employee has previously received the complete hepatitis B vaccination series, antibody testing has revealed that the employee is immune, or the vaccine is contraindicated for medical reasons.

WAC 296-62-08001 (Cont.)

(ii) The employer shall not make participation in a prescreening program a prerequisite for receiving hepatitis B vaccination.

(iii) If the employee initially declines hepatitis B vaccination but at a later date while still covered under the standard decides to accept the vaccination, the employer shall make available hepatitis B vaccination at that time.

(iv) The employer shall assure that employees who decline to accept hepatitis B vaccination offered by the employer sign the statement in WAC 296-62-08050, appendix A.

(v) If a routine booster dose(s) of hepatitis B vaccine is recommended by the United States Public Health Service at a future date, such booster dose(s) shall be made available in accordance with (a)(ii) of this subsection.

(c) Post-exposure evaluation and follow-up. Following a report of an exposure incident, the employer shall make immediately available to the exposed employee a confidential medical evaluation and follow-up, including at least the following elements:

(i) Documentation of the route(s) of exposure, and the circumstances under which the exposure incident occurred;

(ii) Identification and documentation of the source individual, unless the employer can establish that identification is infeasible or prohibited by state or local law;

(A) The source individual's blood shall be tested as soon as feasible and after consent is obtained in order to determine HBV and HIV infectivity. If consent is not obtained, the employer shall establish that legally required consent cannot be obtained. When the source individual's consent is not required by law, the source individual's blood, if available, shall be tested and the results documented.

(B) When the source individual is already known to be infected with HBV or HIV, testing for the source individual's known HBV or HIV status need not be repeated.

(C) Results of the source individual's testing shall be made available to the exposed employee, and the employee shall be informed of applicable laws and regulations concerning disclosure of the identity and infectious status of the source individual.

(iii) Collection and testing of blood for HBV and HIV serological status;

(A) The exposed employee's blood shall be collected as soon as feasible and tested after consent is obtained.

(B) If the employee consents to baseline blood collection, but does not give consent at that time for HIV serologic testing, the sample shall be preserved for at least ninety days. If, within ninety days of the exposure incident, the employee elects to have the baseline sample tested, such testing shall be done as soon as feasible.

(iv) Post-exposure prophylaxis, when medically indicated, as recommended by the United States Public Health Service;

(v) Counseling; and

WAC 296-62-08001 (Cont.)

(vi) Evaluation of reported illnesses.

(d) Information provided to the healthcare professional.

(i) The employer shall ensure that the healthcare professional responsible for the employee's hepatitis B vaccination is provided a copy of this regulation.

(ii) The employer shall ensure that the healthcare professional evaluating an employee after an exposure incident is provided the following information:

(A) A copy of this regulation;

(B) A description of the exposed employee's duties as they relate to the exposure incident;

(C) Documentation of the route(s) of exposure and circumstances under which exposure occurred;

(D) Results of the source individual's blood testing, if available; and

(E) All medical records relevant to the appropriate treatment of the employee including vaccination status which are the employer's responsibility to maintain.

(e) Healthcare professional's written opinion. The employer shall obtain and provide the employee with a copy of the evaluating healthcare professional's written opinion within fifteen days of the completion of the evaluation.

(i) The healthcare professional's written opinion for hepatitis B vaccination shall be limited to whether hepatitis B vaccination is indicated for an employee, and if the employee has received such vaccination.

(ii) The healthcare professional's written opinion for post-exposure evaluation and follow-up shall be limited to the following information:

(A) That the employee has been informed of the results of the evaluation; and

(B) That the employee has been told about any medical conditions resulting from exposure to blood or other potentially infectious materials which require further evaluation or treatment.

(iii) All other findings or diagnoses shall remain confidential and shall not be included in the written report.

(f) Medical recordkeeping. Medical records required by this standard shall be maintained in accordance with subsection (8)(a) of this section.

(7) **Communication of hazards to employees.**

(a) Labels and signs.

(i) Labels.

(A) Warning labels shall be affixed to containers of regulated waste, refrigerators and freezers containing blood or other potentially infectious material; and other containers used to store, transport or ship blood or other potentially infectious materials, except as provided in (a)(i)(E), (F), and (G) of this subsection.

(B) Labels required by this section shall include the following legend:

WAC 296-62-08001 (Cont.)

BIOHAZARD

(C) These labels shall be fluorescent orange or orange-red or predominantly so, with lettering and symbols in a contrasting color.

(D) Labels shall be affixed as close as feasible to the container by string, wire, adhesive, or other method that prevents their loss or unintentional removal.

(E) Red bags or red containers may be substituted for labels.

(F) Containers of blood, blood components, or blood products that are labeled as to their contents and have been released for transfusion or other clinical use are exempted from the labeling requirements of subsection (7) of this section.

(G) Individual containers of blood or other potentially infectious materials that are placed in a labeled container during storage, transport, shipment or disposal are exempted from the labeling requirement.

(H) Labels required for contaminated equipment shall be in accordance with this subitem and shall also state which portions of the equipment remain contaminated.

(I) Regulated waste that has been decontaminated need not be labeled or color-coded.

(ii) Signs.

(A) The employer shall post signs at the entrance to work areas specified in subsection (5) of this section, entitled HIV and HBV research laboratory and production facilities, which shall bear the following legend:

WAC 296-62-08001 (Cont.)

BIOHAZARD
(Name of the Infectious Agent)
(Special requirements for entering the area)
(Name, telephone number of the laboratory director
or other responsible person.)

(B) These signs shall be fluorescent orange-red or predominantly so, with lettering and symbols in a contrasting color.

(b) Information and training.

(i) Employers shall ensure that all employees with occupational exposure participate in a training program which must be provided at no cost to the employee and during working hours.

(ii) Training shall be provided as follows:

(A) At the time of initial assignment to tasks where occupational exposure may take place;

(B) Within ninety days after the effective date of the standard; and

(C) At least annually thereafter.

(iii) For employees who have received training on bloodborne pathogens in the year preceding the effective date of the standard, only training with respect to the provisions of the standard which were not included need be provided.

(iv) Annual training for all employees shall be provided within one year of their previous training.

(v) Employers shall provide additional training when changes such as modification of tasks or procedures or institution of new tasks or procedures affect the employee's occupational exposure. The additional training may be limited to addressing the new exposures created.

(vi) Material appropriate in content and vocabulary to educational level, literacy, and language of employees shall be used.

WAC 296-62-08001 (Cont.)

(vii) The training program shall contain at a minimum the following elements:

(A) An accessible copy of the regulatory text of this standard and an explanation of its contents;

(B) A general explanation of the epidemiology and symptoms of bloodborne diseases;

(C) An explanation of the modes of transmission of bloodborne pathogens;

(D) An explanation of the employer's exposure control plan and the means by which the employee can obtain a copy of the written plan;

(E) An explanation of the appropriate methods for recognizing tasks and other activities that may involve exposure to blood and other potentially infectious materials;

(F) An explanation of the use and limitations of methods that will prevent or reduce exposure including appropriate engineering controls, work practices, and personal protective equipment;

(G) Information on the types, proper use, location, removal, handling, decontamination and disposal of personal protective equipment;

(H) An explanation of the basis for selection of personal protective equipment;

(I) Information on the hepatitis B vaccine, including information on its efficacy, safety, method of administration, the benefits of being vaccinated, and that the vaccine and vaccination will be offered free of charge;

(J) Information on the appropriate actions to take and persons to contact in an emergency involving blood or other potentially infectious materials;

(K) An explanation of the procedure to follow if an exposure incident occurs, including the method of reporting the incident and the medical follow-up that will be made available;

(L) Information on the post-exposure evaluation and follow-up that the employer is required to provide for the employee following an exposure incident;

(M) An explanation of the signs and labels and/or color coding required by (a) of this subsection; and

(N) An opportunity for interactive questions and answers with the person conducting the training session.

(viii) The person conducting the training shall be knowledgeable in the subject matter covered by the elements contained in the training program as it relates to the workplace that the training will address.

WAC 296-62-08001 (Cont.)

(ix) Additional initial training for employees in HIV and HBV laboratories and production facilities. Employees in HIV or HBV research laboratories and HIV or HBV production facilities shall receive the following initial training in addition to the above training requirements:

(A) The employer shall assure that employees demonstrate proficiency in standard microbiological practices and techniques and in the practices and operations specific to the facility before being allowed to work with HIV or HBV.

(B) The employer shall assure that employees have prior experience in the handling of human pathogens or tissue cultures before working with HIV or HBV.

(C) The employer shall provide a training program to employees who have no prior experience in handling human pathogens. Initial work activities shall not include the handling of infectious agents. A progression of work activities shall be assigned as techniques are learned and proficiency is developed. The employer shall assure that employees participate in work activities involving infectious agents only after proficiency has been demonstrated.

(8) **Recordkeeping.**

(a) Medical records.

(i) The employer shall establish and maintain an accurate record for each employee with occupational exposure, in accordance with WAC 296-62-052.

(ii) This record shall include:

(A) The name and Social Security number of the employee;

(B) A copy of the employee's hepatitis B vaccination status including the dates of all the hepatitis B vaccinations and any medical records relative to the employee's ability to receive vaccination as required by subsection (6)(b) of this section;

(C) A copy of all results of examinations, medical testing, and follow-up procedures as required by subsection (6)(c) of this section;

(D) The employer's copy of the healthcare professional's written opinion as required by subsection (6)(e) of this section; and

(E) A copy of the information provided to the healthcare professional as required by subsection (6)(d)(ii)(B), (C), and (D) of this section.

(iii) Confidentiality. The employer shall ensure that employee medical records required by (a) of this subsection are:

(A) Kept confidential; and

(B) Not disclosed or reported without the employee's express written consent to any person within or outside the workplace except as required by this section or as may be required by law.

WAC 296-62-08001 (Cont.)

(iv) The employer shall maintain the records required by subsection (8) of this section for at least the duration of employment plus thirty years in accordance with WAC 296-62-052.

(b) Training records.

(i) Training records shall include the following information:

(A) The dates of the training sessions;

(B) The contents or a summary of the training sessions;

(C) The names and qualifications of persons conducting the training; and

(D) The names and job titles of all persons attending the training sessions.

(ii) Training records shall be maintained for three years from the date on which the training occurred.

(c) Availability.

(i) The employer shall ensure that all records required to be maintained by this section shall be made available upon request to the director for examination and copying.

(ii) Employee training records required by this section shall be provided upon request for examination and copying to employees, to employee representatives, and to the director.

(iii) Employee medical records required by this section shall be provided upon request for examination and copying to the subject employee, to anyone having written consent of the subject employee, to the director in accordance with WAC 296-62-052.

(d) Transfer of records.

(i) The employer shall comply with the requirements involving transfer of records set forth in WAC 296-62-052.

(ii) If the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, the employer shall notify the director, at least three months prior to their disposal and transmit them to the director, if required by the director to do so, within that three-month period.

(e) Sharps injury log.

(i) The employer shall establish and maintain a sharps injury log for the recording of precutaneous injuries from contaminated sharps. The information in the sharps injury log shall be recorded and maintained in such a manner as to protect the confidentiality of the injured employee. The sharps injury log shall contain, at a minimum:

(A) The type and brand of device involved in the incident;

(B) The department or work area where the exposure incident occurred; and

(C) An explanation of how the incident occurred.

WAC 296-62-08001 (Cont.)

(ii) The requirement to establish and maintain a sharps injury log shall apply to any employer who is required to maintain a log of occupational injuries and illnesses under chapter 296-27 WAC, Recordkeeping and recording.

(iii) The sharps injury log shall be maintained for the period required by WAC 296-27-070, Retention of records.

(9) **Dates.**

(a) Effective date. The standard shall become effective on May 26, 1992.

(b) The exposure control plan required by subsection (3) of this section shall be completed on or before June 26, 1992.

(c) Subsection (7)(b) of this section, entitled Information and training; and subsection (7)(h) of this section, entitled Recordkeeping; shall take effect on or before July 27, 1992.

(d) Subsection (4)(b) of this section, entitled Engineering and work practice controls; subsection (4)(c) of this section, entitled Personal protective equipment; subsection (4)(d) of this section, entitled Housekeeping; subsection (5) of this section, entitled HIV and HBV research laboratories and production facilities; subsection (6) of this section, entitled Hepatitis B vaccination and post-exposure evaluation and follow-up; and subsection (7)(a) of this section, entitled Labels and signs; shall take effect August 27, 1992.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-13-078 (Order 01-07), § 296-62-08001, filed 06/19/01, effective 08/06/01. Statutory Authority: Chapter 49.17 RCW. 93-01-067 (Order 92-15), 296-62-08001, filed 12/11/92, effective 1/15/93; 92-08-100 (Order 92-01), 296-62-08001, filed 4/1/92, effective 5/5/92.]

WAC 296-62-08005 Appendix A--Hepatitis B vaccine declination--Mandatory. I understand that due to my occupational exposure to blood or other potentially infectious materials I may be at risk of acquiring hepatitis B virus (HBV) infection. I have been given the opportunity to be vaccinated with hepatitis B vaccine, at no charge to myself. However, I decline hepatitis B vaccination at this time. I understand that by declining this vaccine, I continue to be at risk of acquiring hepatitis B, a serious disease. If in the future I continue to have occupational exposure to blood or other potentially infectious materials and I want to be vaccinated with hepatitis B vaccine, I can receive the vaccination series at no charge to me.

[Statutory Authority: Chapter 49.17 RCW. 92-08-100 (Order 92-01), 296-62-08050, filed 4/1/92, effective 5/5/92.]

PART J-1
PHYSICAL AGENTS

WAC

WAC 296-62-090 Physical agents.

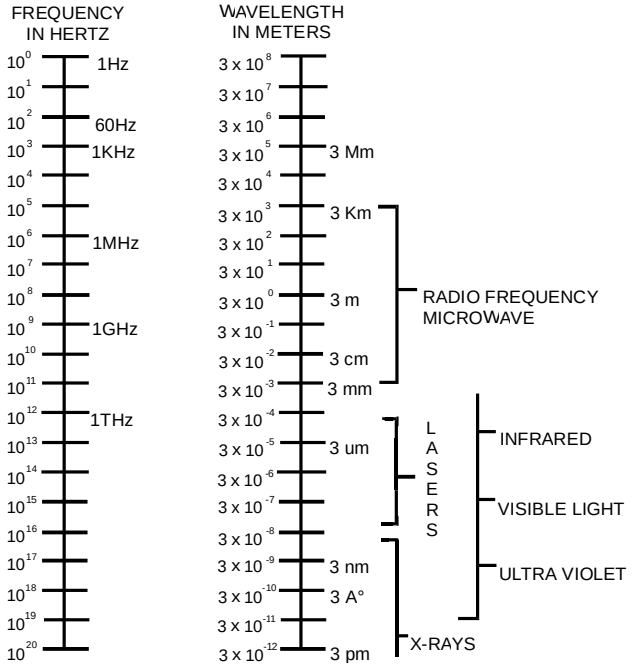
[Order 73-3, 296-62-090, filed 5/7/73; Order 70-8, 296-62-090, filed 7/31/70, effective 9/1/70; Rule 9.010, effective 8/1/63.]

WAC 296-62-09001 Definitions.

(1) **"Physical agents"** shall mean, but are not limited to: Illumination, ionizing radiation, nonionizing radiation, pressure, vibration, temperature and humidity, and noise.

(2) **"Nonionizing radiation"** as related to industrial sources, means electromagnetic radiation within the spectral range of approximately 200 nanometers to 3 kilometers including ultraviolet, visible, infrared and radiofrequency/microwave radiation. The electromagnetic spectrum is shown graphically in Figure 1 below.

ELECTROMAGNETIC SPECTRUM
Figure 1



WAC 96-62-09001 (Cont.)

(3) **Pressure is a barometric force**. Positive pressure would be that above 14.7 lbs. per square inch absolute and negative pressure would be that below 14.7 lbs. per square inch absolute. 14.7 lbs. per square inch equals 760 mm. mercury.

(4) **"Vibration"** means rapid movement to and fro or oscillating movement.

(5) **"Noise"** means unwanted sound or loud discordant or disagreeable sound or sounds.

(6) **"Temperature"** means the degree of hotness or coldness measured by use of a thermometer.

(7) **"Radiant heat"** means infrared radiation emitted from hot surfaces.

(8) "**Relative humidity"** means the percent of moisture in the air compared to the maximum amount of moisture the air could contain at the same temperature.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 85-01-022 (Order 84-24), 296-62-09001, filed 12/11/84; Order 73-3, 296-62-09001, filed 5/7/73.]

WAC 296-62-09004 Ionizing radiation.

(1) **Definitions** applicable to this section.

Note: Definitions also appear in some subsections.

(a) **"Radiation"** includes alpha rays, beta rays, gamma rays, x-rays, neutrons, high-speed electrons, high-speed protons, and other atomic particles; but such term does not include sound or radio waves, or visible light, or infrared or ultraviolet light.

(b) **"Radioactive material"** means any material which emits, by spontaneous nuclear disintegration, corpuscular or electromagnetic emanations.

(c) **"Restricted area"** means any area access to which is controlled by the employer for purposes of protection of individuals from exposure to radiation or radioactive materials.

(d) **"Unrestricted area"** means any area access to which is not controlled by the employer for purposes of protection of individuals from exposure to radiation or radioactive materials.

(e) **"Dose"** means the quantity of ionizing radiation absorbed, per unit of mass, by the body or by any portion of the body. When the provisions in this section specify a dose during a period of time, the dose is the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units used in this section are set forth in subdivisions (f) and (g) of this subsection.

(f) **"Rad"** means a measure of the dose of any ionizing radiation to body tissues in terms of the energy absorbed per unit of mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue (1 millirad (mrad) = 0.001 rad).

(g) **"Rem"** means a measure of the dose of any ionizing radiation to body tissue in terms of its estimated biological effect relative to a dose of 1 roentgen (r) of x-rays (1 millirem (mrem) = 0.001 rem). The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions for irradiation. Each of the following is considered to be equivalent to a dose of 1 rem:

(i) A dose of 1 roentgen due to x- or gamma radiation;

WAC 296-62-09004 (Cont.)

(ii) A dose of 1 rad due to x-, gamma, or beta radiation;

(iii) A dose of 0.1 rad due to neutrons or high energy protons;

(iv) A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye;

(v) If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in item (iii) of this subdivision, 1 rem of neutron radiation may, for purposes of the provisions in this section be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there is sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to 1 rem may be estimated from the following table:

Neutron Flux Dose Equivalents		
Neutron Energy (million electron volts (Mev))	**Number of Neutrons per Square centimeter Equivalent to a Dose of 1 rem (neutron/cm^2)**	**Average flux To deliver 100 millirem in 40 hours (neutrons/cm^2 per sec.)**
Thermal	970 X 10(6)	670
0.0001	720 X 10(6)	500
0.005	820 X 10(6)	570
0.02	400 X 10(6)	280
0.1	120 X 10(6)	80
0.5	43 X 10(6)	30
1.0	26 X 10(6)	18
2.5	29 X 19(6)	20
5.0	26 X 10(6)	18
7.5	24 X 10(6)	17
10	24 X 10(6)	17
10 to 30	14 X 10(6)	10

(h) For determining exposures to x- or gamma rays up to 3 Mev., the dose limits specified in this section may be assumed to be equivalent to the "air dose." For the purpose of this section **"air dose"** means that the dose is measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of the highest dosage rate.

(i) **"Curie"** means a unit of measurement of radioactivity. One curie (Ci) is that quantity of radioactive material which decays at the rate of 2.2 x 10^{12} disintegrations per minute (dpm).

(i) One millicurie (mCi) = 10^{-3}Ci

(ii) One microcurie (uCi) = 10^{-6}Ci

(iii) One nanocurie (nCi) = 10^{-9}Ci

(iv) One picocurie (pCi) = 10^{-12}Ci

WAC 296-62-09004 (Cont.)

(2) **Nuclear Regulatory Commission licensees**--NRC contractors operating NRC plants and facilities.

(a) Any employer who possesses or uses source material, byproduct material, or special nuclear material, as defined in the Atomic Energy Act of 1954, as amended, under a license issued by the Nuclear Regulatory Commission and in accordance with the requirements of chapter 402-24 WAC shall be deemed to be in compliance with the requirements of this section with respect to such possession and use.

(b) NRC contractors operating NRC plants and facilities: Any employer who possesses or uses source material, byproduct material, special nuclear material, or other radiation sources under a contract with the Nuclear Regulatory Commission for the operation of NRC plants and facilities and in accordance with the standards, procedures, and other requirements for radiation protection established by the commission for such contract pursuant to the Atomic Energy Act of 1954 as amended (42 U.S.C. 2011 et seq.) shall be deemed to be in compliance with the requirements of this section with respect to such possession and use.

(c) State licensees or registrants:

(i) Atomic Energy Act sources. Any employer who possesses or uses source material, byproduct material, or special nuclear material, as defined in the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), and has registered such sources with, the state shall be deemed to be in compliance with the radiation requirements of this section, insofar as his possession and use of such material is concerned.

(ii) Other sources. Any employer who possesses or uses radiation sources other than source material, byproduct material, or special nuclear material, as defined in the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.), and has registered such sources with the state shall be deemed to be in compliance with the radiation requirements of this section insofar as his possession and use of such material is concerned.

(3) **Exposure of individuals to radiation in restricted areas.**

(a) Except as provided in subdivision (b) of this subsection, no employer shall possess, use, or transfer sources of ionizing radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from sources in the employer's possession or control a dose in excess of the limits specified in the following table:

EXPOSURE IN RESTRICTED AREAS	**Rems per Calendar Quarter**
Whole body. Head and trunk, active blood forming organs, lens of eyes, or gonads.	1-1/4
Hand and forearms, feet and ankles.	18-3/4
Skin of whole body.	7-1/2

(b) An employer may permit an individual in a restricted area to receive doses to the whole body greater than those permitted under subdivision (a) of this subsection, so long as:

(i) During any calendar quarter the dose to the whole body shall not exceed 3 rems; and

WAC 296-62-09004 (Cont.)

(ii) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems, where "N" equals the individual's age in years at his last birthday; and

(iii) The employer maintains adequate past and current exposure records which show that the addition of such a dose will not cause the individual to exceed the amount authorized in this subdivision. As used in this subdivision "Dose to the whole body" shall be deemed to include any dose to the whole body, gonad, active blood-forming organs, head and trunk, or lens of the eye.

(c) No employer shall permit any employee who is under 18 years of age to receive in any period of one calendar quarter a dose in excess of 10 percent of the limits specified in the preceding table entitled "exposure in restricted areas."

(d) **"Calendar quarter"** means any 3-month period determined as follows:

(i) The first period of any year may begin on any date in January: Provided, That the second, third and fourth periods accordingly begin on the same date in April, July, and October, respectively, and that the fourth period extends into January of the succeeding year, if necessary to complete a 3-month quarter. During the first year of use of this method of determination, the first period for that year shall also include any additional days in January preceding the starting date for the first period; or

(ii) The first period in a calendar year of 13 complete, consecutive calendar weeks; the second period in a calendar year of 13 complete consecutive weeks; the third period in a calendar year of 13 complete, consecutive calendar weeks; the fourth period in a calendar year of 13 complete, consecutive calendar weeks. If at the end of a calendar year there are any days not falling within a complete calendar week of that year, such days shall be included within the last complete calendar week of that year. If at the beginning of any calendar year there are days not falling within a complete calendar week of that year, such days shall be included within the last complete calendar week of the previous year; or

(iii) The four periods in a calendar year may consist of the first 14 complete, consecutive calendar weeks; the next 12 complete, consecutive calendar weeks, the next 14 complete, consecutive calendar weeks, and the last 12 complete, consecutive calendar weeks. If at the end of a calendar year there are any days not falling within a complete calendar week of that year, such days shall be included (for purposes of this section) within the last complete calendar week of the year. If at the beginning of any calendar year there are days not falling within a complete calendar week of that year, such days shall be included (for purposes of this section) within the last complete week of the previous year.

(e) No employer shall change the method used by him to determine calendar quarters except at the beginning of a calendar year.

(4) **Exposure to airborne radioactive material.**

(a) No employer shall possess, use or transport radioactive material in such a manner as to cause any employee, within a restricted area, to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Table I of WAC 402-24-220, Appendix A. The limits given in Table I are for exposure to the concentrations specified for 40 hours in any workweek of 7 consecutive days. In any such period where the number of hours of exposure is less than 40 the limits specified in the table may be increased proportionately. In any such period where the number of hours of exposure is greater than 40, the limits specified in the table shall be decreased proportionately.

WAC 296-62-09004 (Cont.)

(b) No employer shall possess, use, or transfer radioactive material in such a manner as to cause any individual within a restricted area, who is under 18 years of age, to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Table II of WAC 402-24-220, Appendix A.

For purposes of this subdivision, concentrations may be averaged over periods not greater than 1 week.

(c) **"Exposed"** as used in this subdivision means that the individual is present in an airborne concentration. No allowance shall be made for the use of protective clothing or equipment, or particle size.

(5) **Precautionary procedures and personal monitoring.**

(a) Every employer shall make such surveys as may be necessary for him to comply with the provisions in this section. **"Survey"** means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of radioactive materials or other sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Every employer shall supply appropriate personnel monitoring equipment, such as film badges, pocket chambers, pocket dosimeters, or film rings, to, and shall require the use of such equipment by:

(i) Each employee who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in subsection (3)(a) of this section; and

(ii) Each employee under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive a dose in any calendar quarter in excess of 5 percent of the applicable value specified in subsection (3)(a) of this section; and

(iii) Each employee who enters a high radiation area.

(c) As used in this section:

(i) **"Personnel monitoring equipment"** means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e.g., film badges, pocket chambers, pocket dosimeters, film rings, etc.);

(ii) **"Radiation area"** means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any 1 hour a dose in excess of 5 millirem, or in any 5 consecutive days a dose in excess of 100 millirem; and

(iii) **"High radiation area"** means any area, accessible to personnel, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirem.

(6) **Caution signs, labels and signals.**

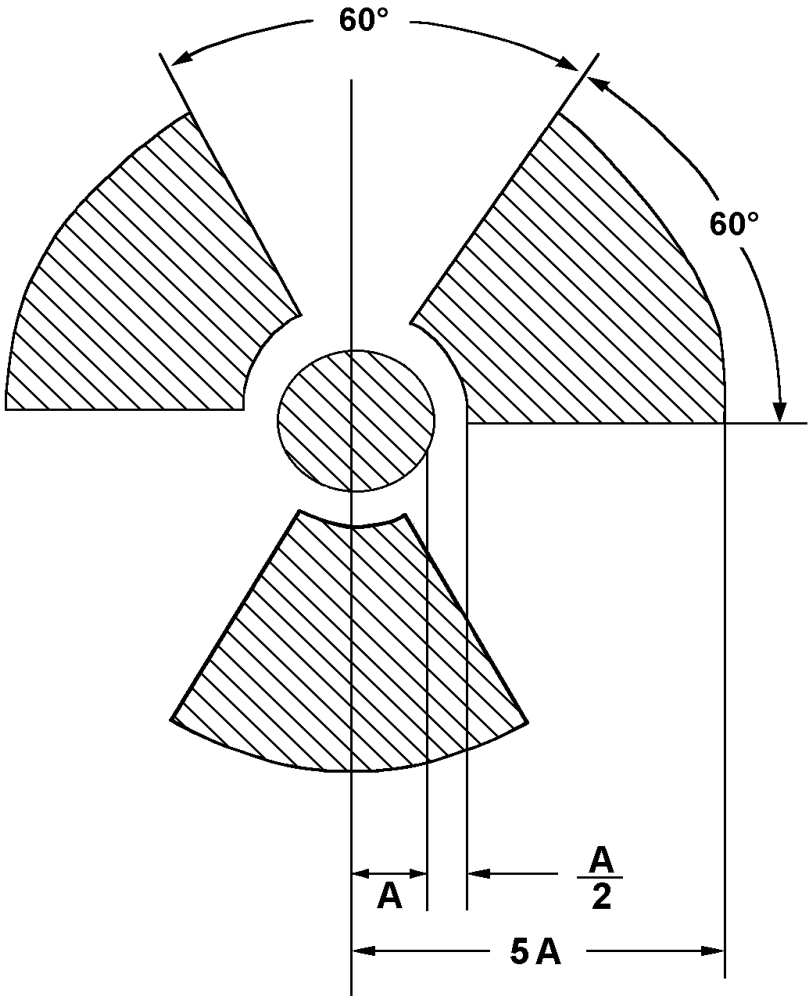
(a) General.

WAC 296-62-09004 (Cont.)

(i) Symbols prescribed by this subsection shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this subsection is the conventional three-bladed design:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



WAC 296-62-09004 (Cont.)

(ii) In addition to the contents of signs and labels prescribed in this subsection, employers may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation or to radioactive material.

(b) Radiation area. Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol described in subdivision (a) of this subsection and the words:

CAUTION
RADIATION AREA

(c) High radiation area.

(i) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION
HIGH RADIATION AREA

(ii) Each high radiation area shall be equipped with a control device which shall either cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirems in 1 hour upon entry into the area or shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering and the employer or a supervisor of the activity are made aware of the entry. In the case of a high radiation area established for a period of 30 days or less, such control device is not required.

(d) Airborne radioactivity area.

(i) As used in the provisions of this section, **"airborne radioactivity area"** means:

(A) Any room, enclosure, or operating area in which airborne radioactive materials, composed wholly or partly of radioactive material, exist in concentrations in excess of the amounts specified in column 1 of Table I of WAC 402-24-220, Appendix A.

(B) Any room, enclosure, or operating area in which airborne radioactive materials exist in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in column 1 of Table I of WAC 402-24-220, Appendix A.

(ii) Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol described in subdivision (a) of this subsection and the words:

CAUTION
AIRBORNE RADIOACTIVITY AREA

(e) Additional requirements.

(i) Each area or room in which radioactive material is used or stored and which contains any radioactive material (other than natural uranium or thorium) in any amount exceeding 10 times the quantity of such material specified in WAC 402-24-230, Appendix B shall be conspicuously posted with a sign or signs bearing the radiation caution symbol described in subdivision (a) of this subsection and the words:

WAC 296-62-09004 (Cont.)

CAUTION
RADIOACTIVE MATERIALS

(ii) Each area or room in which natural uranium or thorium is used or stored in an amount exceeding 100 times the quantity of such material specified in chapter 402-24 WAC shall be conspicuously posted with a sign or signs bearing the radiation caution symbol described in subdivision (a) of this subsection and the words:

CAUTION
RADIOACTIVE MATERIALS

(f) Containers.

(i) Each container in which is transported, stored, or used a quantity of any radioactive material (other than natural uranium or thorium) greater than the quantity of such material specified in WAC 402-24-230, Appendix B shall bear a durable, clearly visible label bearing the radiation caution symbol described in subdivision (a) of this subsection and the words:

CAUTION
RADIOACTIVE MATERIALS

(ii) Each container in which natural uranium or thorium is transported, stored, or used in a quantity greater than 10 times the quantity specified in WAC 402-24-230, Appendix B shall bear a durable, clearly visible label bearing the radiation caution symbol described in subdivision (a) of this subsection and the words:

CAUTION
RADIOACTIVE MATERIALS

(iii) Notwithstanding the provisions of items (i) and (ii) of this subdivision a label shall not be required:

(A) If the concentration of the material in the container does not exceed that specified in column 2 of Table I of WAC 402-24-220, Appendix A.

(B) For laboratory containers, such as beakers, flasks, and test tubes, used transiently in laboratory procedures, when the user is present.

(iv) Where containers are used for storage, the labels required in this subdivision shall state also the quantities and kinds of radioactive materials in the containers and the date of measurement of the quantities.

(7) **Immediate evacuation warning signal.**

(a) Signal characteristics.

(i) The signal shall be a midfrequency complex sound wave amplitude modulated at a subsonic frequency. The complex sound wave in free space shall have a fundamental frequency f1 between 450 and 500 hertz (Hz) modulated at a subsonic rate between 4 and 5 hertz.

(ii) The signal generator shall not be less than 75 decibels at every location where an individual may be present whose immediate, rapid, and complete evacuation is essential.

WAC 296-62-09004 (Cont.)

(iii) A sufficient number of signal units shall be installed such that the requirements of item (i) of this subdivision are met at every location where an individual may be present whose immediate, rapid, and complete evacuation is essential.

(iv) The signal shall be unique in the plant or facility in which it is installed.

(v) The minimum duration of the signal shall be sufficient to insure that all affected persons hear the signal.

(vi) The signal-generating system shall respond automatically to an initiating event without requiring any human action to sound the signal.

(b) Design objectives.

(i) The signal-generating system shall be designed to incorporate components which enable the system to produce the desired signal each time it is activated within one-half second of activation.

(ii) The signal-generating system shall be provided with an automatically activated secondary power supply which is adequate to simultaneously power all emergency equipment to which it is connected, if operation during power failure is necessary, except in those systems using batteries as the primary source of power.

(iii) All components of the signal-generating system shall be located to provide maximum practicable protection against damage in case of fire, explosion, corrosive atmosphere, or other environmental extremes consistent with adequate system performance.

(iv) The signal-generating system shall be designed with the minimum number of components necessary to make it function as intended, and should utilize components which do not require frequent servicing such as lubrication or cleaning.

(v) Where several activating devices feed activating information to a central signal generator, failure of any activating device shall not render the signal-generator system inoperable to activating information from the remaining devices.

(vi) The signal-generating system shall be designed to enhance the probability that alarm occurs only when immediate evacuation is warranted. The number of false alarms shall not be so great that the signal will come to be disregarded and shall be low enough to minimize personal injuries or excessive property damage that might result from such evacuation.

(c) Testing.

(i) Initial tests, inspections, and checks of the signal-generating system shall be made to verify that the fabrication and installation were made in accordance with design plans and specifications and to develop a thorough knowledge of the performance of the system and all components under normal and hostile conditions.

(ii) Once the system has been placed in service, periodic tests, inspections, and checks shall be made to minimize the possibility of malfunction.

(iii) Following significant alterations or revisions to the system, tests and checks similar to the initial installation tests shall be made.

WAC 296-62-09004 (Cont.)

(iv) Tests shall be designed to minimize hazards while conducting the tests.

(v) Prior to normal operation the signal-generating system shall be checked physically and functionally to assure reliability and to demonstrate accuracy and performance. Specific tests shall include:

(A) All power sources.

(B) Calibration and calibration stability.

(C) Trip levels and stability.

(D) Continuity of function with loss and return of required services such as AC or DC power, air pressure, etc.

(E) All indicators.

(F) Trouble indicator circuits and signals, where used.

(G) Air pressure (if used).

(H) Determine that sound level of the signal is within the limit of item (a)(ii) of this subsection at all points that require immediate evacuation.

(vi) In addition to the initial startup and operating tests, periodic scheduled performance tests and status checks must be made to insure that the system is at all times operating within design limits and capable of the required response. Specific periodic tests or checks or both shall include:

(A) Adequacy of signal activation device.

(B) All power sources.

(C) Function of all alarm circuits and trouble indicator circuits including trip levels.

(D) Air pressure (if used).

(E) Function of entire system including operation without power where required.

(F) Complete operational tests including sounding of the signal and determination that sound levels are adequate.

(vii) Periodic tests shall be scheduled on the basis of need, experience, difficulty, and disruption of operations. The entire system should be operationally tested at least quarterly.

(viii) All employees whose work may necessitate their presence in an area covered by the signal shall be made familiar with the actual sound of the signal--preferably as it sounds at their work location. Before placing the system into operation, all employees normally working in the area shall be made acquainted with the signal by actual demonstration at their work locations.

WAC 296-62-09004 (Cont.)

(8) **Exceptions from posting requirements.** Notwithstanding the provisions of subsection (6) of this section:

(a) A room or area is not required to be posted with a caution sign because of the presence of a sealed source, provided the radiation level 12 inches from the surface of the source container or housing does not exceed 5 millirem per hour.

(b) Rooms or other areas in onsite medical facilities are not required to be posted with caution signs because of the presence of patients containing radioactive material, provided that there are personnel in attendance who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in the provisions of this section.

(c) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than 8 hours: Provided, That

(i) The materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in the provisions of this section; and

(ii) Such area or room is subject to the employer's control.

(9) **Exemptions for radioactive materials packaged for shipment.** Radioactive materials packaged and labeled in accordance with regulations of the Department of Transportation published in 49 CFR Chapter I, are exempt from the labeling and posting requirements of this section during shipment, provided that the inside containers are labeled in accordance with the provisions of subsection (6) of this section.

(10) **Instruction of personnel, posting.**

(a) Employers regulated by the Nuclear Regulatory Commission shall be governed by 10 CFR Part 20 standards. Employers conducting business in Washington state shall be governed by the requirements of the laws and regulations of the state. All other employers shall be regulated by the following:

(b) All individuals working in or frequenting any portion of a radiation area shall be informed of the occurrence of radioactive materials or of radiation in such portions of the radiation area; shall be instructed in the safety problems associated with exposure to such materials or radiation and in precautions or devices to minimize exposure; shall be instructed in the applicable provisions of this section for the protection of employees from exposure to radiation or radioactive materials; and shall be advised of reports of radiation exposure which employees may request pursuant to the regulations in this section.

(c) Each employer to whom this section applies shall post a current copy of its provisions and a copy of the operating procedures applicable to the work conspicuously in such locations as to insure that employees working in or frequenting radiation areas will observe these documents on the way to and from their place of employment, or shall keep such documents available for examination of employees upon request.

(11) **Storage of radioactive materials.** Radioactive materials stored in a nonradiation area shall be secured against unauthorized removal from the place of storage.

(12) **Waste disposal.** No employer shall dispose of radioactive material except as provided for in WAC 402-24-130.

WAC 296-62-09004 (Cont.)

(13) **Notification of incidents.**

(a) Immediate notification. Each employer shall immediately notify the industrial hygiene section, division of industrial safety and health for employees not protected by the Nuclear Regulatory Commission by means of 10 CFR Part 20; subsection (2)(b) of this section by telephone or telegraph of any incident involving radiation which may have caused or threatens to cause:

(i) Exposure of the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual to 150 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms of any individual to 375 rems or more of radiation; or

(ii) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limit specified for such materials in Table II of WAC 402-24-220, Appendix A.

(iii) A loss of 1 working week or more of the operation of any facilities affected; or

(iv) Damage to property in excess of $100,000.

(b) Twenty-four hour notification. Each employer shall within 24 hours following its occurrence notify the industrial hygiene section, division of industrial safety and health, for employees not protected by the Nuclear Regulatory Commission by means of 10 CFR Part 20; subsection (2)(b) of this section, by telephone or telegraph of any incident involving radiation which may have caused or threatens to cause:

(i) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or

(ii) A loss of 1 day or more of the operation of any facilities; or

(iii) Damage to property in excess of $10,000.

(14) **Reports of overexposure and excessive levels and concentrations.**

(a) In addition to any notification required by subsection (13) of this section each employer shall make a report in writing within 30 days to the industrial hygiene section division of industrial safety and health, for employees not protected by the Nuclear Regulatory Commission by means of 10 CFR Part 20; or under subsection (2)(b) of this section, of each exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit in this section. Each report required under this subdivision shall describe the extent of exposure of persons to radiation or to radioactive material; levels of radiation and concentration of radioactive material involved, the cause of the exposure, levels of concentrations; and corrective steps taken or planned to assure against a recurrence.

(b) In any case where an employer is required pursuant to the provisions of this subsection to report to the industrial hygiene section, division of industrial safety and health, any exposure of an individual to radiation or to concentrations of radioactive material, the employer shall also notify such individual of the nature and extent of exposure. Such notice shall be in writing and shall contain the following statement: “You should preserve this report for future reference.”

WAC 296-62-09004 (Cont.)

(15) **Records.**

(a) Every employer shall maintain records of the radiation exposure of all employees for whom personnel monitoring is required under subsection (5) of this section and advise each of his employees of his individual exposure on at least an annual basis.

(b) Every employer shall maintain records in the same units used in tables in subsection (2) of this section and WAC 402-24-220, Appendix A.

(16) **Disclosure to former employee of individual employee's record.**

(a) At the request of a former employee an employer shall furnish to the employee a report of the employee's exposure to radiation as shown in records maintained by the employer pursuant to subdivision (15)(a) of this section. Such report shall be furnished within 30 days from the time the request is made, and shall cover each calendar quarter of the individual's employment involving exposure to radiation or such lesser period as may be requested by the employee. The report shall also include the results of any calculations and analysis of radioactive material deposited in the body of the employee. The report shall be in writing and contain the following statement: "You should preserve this report for future reference."

(b) The former employee's request should include appropriate identifying data, such as social security number and dates and locations of employment.

(17) (Reserved)

(18) **Radiation standards for mining.**

(a) For the purpose of this subsection, a "working level" is defined as any combination of radon daughters in 1 liter of air which will result in the ultimate emission of 1.3×10^5 million electron volts of potential alpha energy. The numerical value of the "working level" is derived from the alpha energy released by the total decay of short-lived radon daughter products in equilibrium with 100 picocuries of radon 222 per liter of air. A working level month is defined as the exposure received by a worker breathing air at one working level concentration for 4-1/3 weeks of 40 hours each.

(b) Occupational exposure to radon daughters in mines shall be controlled so that no individual will receive an exposure of more than 2 working level months in any calendar quarter and no more than 4 working level months in any calendar year. Actual exposures shall be kept as far below these values as practicable.

(c) (i) For uranium mines, records of environmental concentrations in the occupied parts of the mine, and of the time spent in each area by each person involved in an underground work shall be established and maintained. These records shall be in sufficient detail to permit calculations of the exposures, in units of working level months, of the individuals and shall be available for inspection by the industrial hygiene section, division of safety and health or their authorized representatives.

(ii) For other than uranium mines and for surface workers in all mines, item (i) of this subdivision will be applicable: Provided, however, That if no environmental sample shows a concentration greater than 0.33 working level in any occupied part of the mine, the maintenance of individual occupancy records and the calculation of individual exposures will not be required.

(d) (i) At the request of an employee (or former employee) a report of the employee's exposure to radiation as shown in records maintained by the employer pursuant to subdivision (c) of this subsection shall be furnished to him. The report shall be in writing and contain the following statement:

WAC 296-62-09004 (Cont.)

"This report is furnished to you under the provisions of the state of Washington, Ionizing Radiation Safety and Health Standards (chapter 296-62 WAC). You should preserve this report for future reference."

(ii) The former employee's request should include appropriate identifying data, such as Social Security number and dates and locations of employment. See tables in WAC 402-24-220, Appendix A and 402-24-230, Appendix B.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 85-01-022 (Order 84-24), 296-62-09004, filed 12/11/84; Order 75-15, 296-62-09004, filed 4/18/75.]

WAC 296-62-09005 Nonionizing radiation.

(1) **Introduction.** Employees shall be protected from exposure to hazardous levels of nonionizing radiation. Health standards have been established for ultraviolet, radiofrequency/microwave, and laser radiations which shall be used to promote a healthful working environment. These standards refer to levels of nonionizing radiation and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effects. They are based on the best available information from experimental studies. Because of the wide variations in individual susceptibility, exposure of an occasional individual at, or even below, the permissible limit, may result in discomfort, aggravation of a preexisting condition, or physiological damage.

(a) Permissible exposure limits (PELs) refer to a time weighted average (TWA) of exposure for an 8-hour work day within a 40-hour workweek. Exceptions are those limits which are given a ceiling value.

(b) These PELs should be interpreted and applied only by technically qualified persons.

(c) Ceiling value. There are nonionizing radiations which produce physiological responses from short intense exposure and the PELs for these radiations are more appropriately based on this particular hazard. Nonionizing radiations with this type of hazard are best controlled by a ceiling value which is a maximum level of exposure which shall not be exceeded.

(2) The employer shall establish and maintain a program for the control and monitoring of nonionizing radiation hazards. This program shall provide employees adequate supervision, training, facilities, equipment, and supplies, for the control and assessment of nonionizing radiation hazards.

(3) **Radiofrequency/microwave radiation permissible exposure limits.**

(a) Definition: **"Partial body exposure"** means the case in which only the hands and forearms or the feet and legs below the knee are exposed.

(b) Warning symbol.

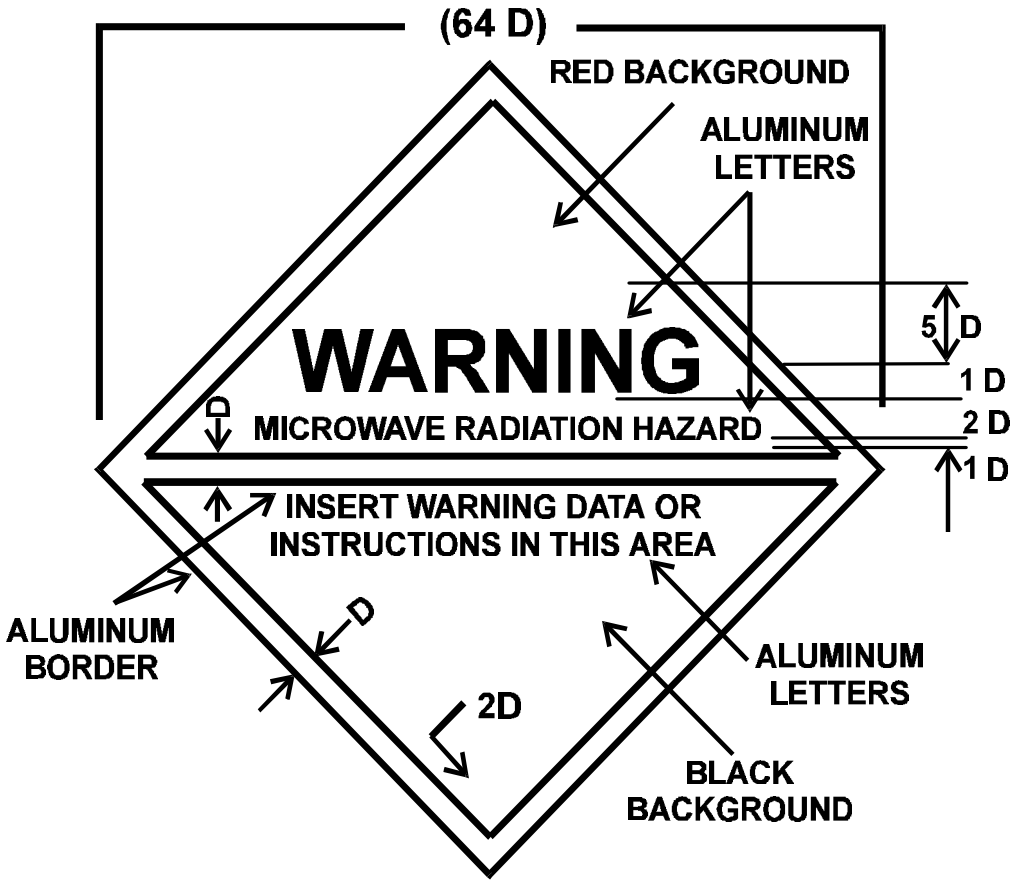
(i) The warning symbol for radiofrequency/microwave radiation shall consist of a red isosceles triangle above an inverted black isosceles triangle, separated and outlined by an aluminum color border. The words "Warning - Radiofrequency/microwave radiation hazard" shall appear in the upper triangle. See Figure 1.

(ii) All areas where entry may result in an exposure to radiofrequency/microwave radiation in excess of the PEL shall have a warning symbol prominently displayed at their entrance.

(iii) American National Standard Safety Color Code for Marking Physical Hazards and the Identification of Certain Equipment, Z53.1-1953, shall be used for color specification. All lettering and the border shall be of aluminum color.

WAC 296-62-09005 (Cont.)

(iv) The inclusion and choice of warning information or precautionary instructions is at the discretion of the user. If such information is included it shall appear in the lower triangle of the warning symbol.



1. Place handling and mounting instructions on reverse side.
2. D = Scaling Unit.
3. Lettering: Ratio of letter height to thickness of letter lines.

Upper triangle:	5 to 1	Large
	6 to 1	Medium
Lower triangle:	4 to 1	Small
	6 to 1	Medium

4. Symbol is square, triangles are right-angle isosceles.

(c) These PELs refer to radiofrequency/microwave radiation exposures in the frequency range of 300 kHz to 100 GHz. Based on current knowledge, it is believed that workers may be exposed at these PELs without adverse health effects.

(i) Table I gives the PELs in terms of the mean squared electric (E2) and magnetic (H2) field strengths and in terms of the equivalent plane-wave free-space power density, as a function of frequency.

(ii) The average exposure for any 6 minute (0.1 hour) period shall not exceed the PEL.

(iii) Measurements shall be made at distances of 5 cm or greater from any object.

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(iv) For mixed or broadband fields at a number of frequencies for which there are different PELs, the fraction of the PEL incurred within each frequency interval shall be determined and the sum of these fractions shall not exceed unity.

(v) PELs given in Table I for frequencies between 300 kHz and 1 GHz may be exceeded for partial body exposures if the output power of the radiating device is 7 watts or less.

Table I. Radiofrequency/Microwave Radiation Permissible Exposure Limis (PELs).

Frequency(f)	Power Density* mW/cm^2	Electric Field Strength Squared* V^2/m^2	Magnetic Field Strength Squared* A^2/m^2
0.3 to 3 MHz	100	400,000	2.5
3 to 30 MHz	$900/f^2$	$4000(900/f^2)$	$0.025(900/f^2)$
30 to 300 MHz	1.0	4000	0.025
300 to 1500 MHz	f/300	4000(f/300)	0.025(f/300)
1.5 to 100 GHz	5.0	20,0000	125

Note: f = frequency (MHz)
*Ceiling value`

(4) **Laser radiation permissible exposure limits.**

(a) Definitions.

(i) **"Diffuse reflection"** means a change of the spatial distribution of a beam of radiation when it is reflected in many directions by a surface or medium.

(ii) **"Specular reflection"** means a mirrorlike reflection.

(iii) **"Accessible radiation"** means laser radiation to which human access is possible.

(b) All lasers and laser systems shall be classified in accordance with the Federal Laser Product Performance Standards (21 CFR 1040.10) or, if manufactured prior to August 2, 1976, in accordance with ANSI Z136.1-1980.

(i) Class I. Laser systems that are considered to be incapable of producing damaging radiation levels and are thereby exempt from control measures. This is a no hazard category.

(ii) Class II. Visible wavelength laser systems that have a low hazard potential because of the expected aversion response. There is some possibility of injury if stared at. This is a low hazard category.

(iii) Class III. Laser systems in which intrabeam viewing of the direct beam or specular reflections of the beam may be hazardous. This class is further subdivided into IIIa and IIIb. This is a moderate hazard category.

(iv) Class IV. Laser systems whose direct or diffusely reflected radiation may be hazardous and where the beam may constitute a fire hazard. Class IV systems require the use of controls that prevent exposure of the eye and skin to specular or diffuse reflections of the beam. This is a high hazard category.

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(c) Warning signs and classification labels shall be prepared in accordance with 21 CFR 1040.10 when classifying lasers and laser systems, and ANSI Z136.1 - 1980 when using classified lasers and laser systems. All signs and labels shall be conspicuously displayed.

(i) The signal word "caution" shall be used with all signs and labels associated with Class II and Class IIIa lasers and laser systems.

(ii) The signal word "danger" shall be used with all signs and labels associated with Class IIIb and Class IV lasers and laser systems.

(d) Personal protective equipment shall be provided at no cost to the employee and shall be worn whenever operational conditions or maintenance of lasers may result in a potentially hazardous exposure.

(i) Protective eyewear shall be specifically designed for protection against radiation of the wavelength and radiant energy of the laser or laser system. Ocular exposure shall not exceed the recommendations of ANSI Z136.1 - 1980.

(ii) For Class IV lasers and laser systems protective eyewear shall be worn for all operational conditions or maintenance which may result in exposures to laser radiation.

(e) Engineering controls shall be used whenever feasible to reduce the accessible radiation levels for Class IV lasers and laser systems to a lower classification level. These controls may include, but are not limited to: Protective housings, interlocks, optical system attenuators, enclosed beam paths, remote controls, beam stops, and emission delays with audible warnings.

(f) All employees who may be exposed to laser radiation shall receive laser safety training. The training shall ensure that the employees are knowledgeable of the potential hazards and control measures for the laser equipment in use.

(5) **Ultraviolet radiation.**

(a) These permissible exposure limits refer to ultraviolet radiation in the spectral region between 200 and 400 nanometer (nm) and represent conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse effect. These values for exposure of the eye or the skin apply to ultraviolet radiation from arcs, gas, and vapor discharges, and incandescent sources, but do not apply to ultraviolet lasers or solar radiation. These levels should not be used for determining exposure of photosensitive individuals to ultraviolet radiation. These values shall be used in the control of exposure to continuous sources where the exposure relation shall not be less than 0.1 sec.

(b) The permissible exposure limit for occupational exposure to ultraviolet radiation incident upon skin or eye where irradiance values are known and exposure time is controlled are as follows:

(i) For the near ultraviolet spectral region (320 to 400 nanometer (nm)), total irradiance incident upon the unprotected skin or eye shall not exceed 1.0 milliwatt/sq. centimeter for periods greater than 103 seconds (approximately 16 minutes) and for exposure times less than 103 seconds shall not exceed one Joule/sq. centimeter.

(ii) For the actinic ultraviolet spectral region (200 - 315 nm), radiant exposure incident upon the unprotected skin or eye shall not exceed the values given in Table 4 within an 8-hour period.

(iii) To determine the effective irradiance of a broadband source weighted against the peak of the spectral effectiveness curve (270 nanometer (nm)), the following weighting formulas shall be used.

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$E_{eff} = \Sigma$ (E-Lambda) (S-Lambda) (Delta-Lambda)

Where:

E_{eff} = effective irradiance relative to a monochromatic source at 270nm

E-Lambda = spectral irradiance in Watts/sq. centimeter/nanometer.

S-Lambda = relative spectral effectiveness (unitless)

Delta-Lambda = band width in nanometers

(iv) Permissible exposure time in seconds for exposure to actinic ultraviolet radiation incident upon the unprotected skin or eye may be computed by dividing 0.003 Joules/sq. centimeter by Eeff in Watts/sq. centimeter. The exposure time may also be determined using Table 5 which provides exposure times corresponding to effective irradiances in μW/cm2.

TABLE 4

Relative PEL Wavelength Nanometer	Spectral Millijoules/sq. Centimeters	Effectiveness S Lambda
200	100	0.03
210	40	0.075
220	25	0.12
230	16	0.19
240	10	0.30
250	7.0	0.43
254	6.0	0.5
260	4.6	0.65
270	3.0	1.0
280	3.4	0.88
290	4.7	0.64
300	10	0.30
305	50	0.06
310	200	0.015
315	1000	0.003

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TABLE 5	
Duration of Exposure Per Day	**Effective Irridance Eeff (μW/cm2)**
8 hrs.	0.1
4 hrs	0.2
2 hrs	0.4
1 hr.	0.8
1/2 hr.	1.7
15 min.	3.3
10 min.	5
5 min.	10
1 min.	50
30 sec.	100
10 sec.	300
1 sec.	3,000
0.5 sec.	6,000
0.1 sec.	30,000

TABLE 6

Densities and Transmissions (in Percent); also Tolerances in Densities and Transmissions of Various Shades of Glasses for Protection Against Injurious Rays
(Shades 3 to 8, inclusive, are for use in goggles, shades 10 to 14, inclusive, for welder's helmets and face shields)

[CODIFICATION NOTE: The graphic presentation of this table has been varied slightly in order that it would fall within the printing specifications for the Washington Administrative Code. In the following table, the original table had columns relating to (1) "Optical Density" which is now "Part 1," (2) "Total Visible Luminous Transmittance" and "Maximum total Infrared" which are now "Part 2," (3) "Maximum Ultraviolet Transmission" which is now "Part 3," and (4) "Recommended Uses" which is now "Part 4." These columns were all positioned side by side. In the new WAC format these are split up into four separate tables.]

TABLE 6--Part 1 Optical Density			
Shade No.	**Minimum O.D.**	**Standard O.D.**	**Maximum O.D.**
3.0	.64	.857	1.06
4.0	1.07	1.286	1.49
5.0	1.50	1.714	1.92
6.0	1.93	2.143	2.35
7.0	2.36	2.572	2.78
8	2.79	3.000	3.21
9	3.22	3.429	3.63
10	3.64	3.857	4.06
11	4.07	4.286	4.49
12	4.50	4.715	4.92
13	4.93	5.143	5.35
14	5.36	5.571	5.78

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TABLE 6--Part 2 Total Visible Luminous Transmittance				
Shade No.	**Maximum %**	**Standard %**	**Minimum %**	**Maximum Total Infrared %**
3.0	22.9	13.9	8.70	9.0
4.0	8.51	5.18	3.24	5.0
5.0	3.16	1.93	1.20	2.5
6.0	1.18	.72	.45	1.5
7.0	.44	.27	.17	1.3
8	.162	.100	.062	1.0
9	.060	.037	.023	.8
10	.0229	.0139	.0087	.6
11	.0085	.0052	.0033	.5
12	.0032	.0019	.0012	.5
13	.00118	.00072	.00045	.4
14	.00044	.00027	.00017	.3

TABLE 6--Part 3 Maximum Ultraviolet Transmission				
Shade No.	**313mu %**	**334mu %**	**365mu %**	**405mu %**
3.0	.2	.2	.5	1.0
4.0	.2	.2	.5	1.0
5.0	.2	.2	.2	.5
6.0	.1	.1	.1	.5
7.0	.1	.1	.1	.5
8	.1	.1	.1	.5
9	.1	.1	.1	.5
10	.1	.1	.1	.5
11	.05	.05	.05	.1
12	.05	.05	.05	.1
13	.05	.05	.05	.1
14	.05	.05	.05	.1

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TABLE 6--Part 4	
Shade No.	**Recommended Uses**
3.0	Glare of reflected sunlight from snow, water, sand, etc., stray light from cutting and welding metal pouring and work around furnaces and foundries.
4.0 5.0	Light acetylene cutting and welding, light electric spot welding.
6.0 7.0	Acetylene cutting and medium welding, arc welding upto 30 amperes.
8 9	Heavy acetylene welding, arc cutting and welding between 30 and 75 amperes.
10 11	Arc cutting and welding between 75 and 200 amperes.
12 13	Arc cutting and welding between 200 and 400 amperes.
14	Arc cutting and welding above 400 amperes.

a. American Standard Safety Code for the Protection of Heads, Eyes, and Respiratory Organs.
b. Standard density is defined as the logarithms (base 10) of the reciprocal of the transmission. Shade number is determined by the density according to the relations:
Shade number = 7/3 density + 1 with tolerances as given in the table.

Note: Safety glasses are available with lenses which protect the eyes against ultraviolet radiation.
[Statutory Authority: Chapter 49.17 RCW and RCW 49.17.040, [49.17].050 and [49.17].060. 92-22-067 (Order 92-06), 296-62-09005, filed 10/30/92, effective 12/8/92. Statutory Authority: RCW 49.17.040 and 49.17.050. 85-01-022 (Order 84-24), 296-62-09005, filed 12/11/84. Statutory Authority: RCW 49.17.040. 80-16-029 (Order 80-22), 296-62-09005, filed 10/31/80. Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 80-11-010 (Order 80-14), 296-62-09005, filed 8/8/80; Order 73-3, 296-62-09005, filed 5/7/73.]

WAC 296-62-09007 Pressure.

(1) Employees exposed to pressures above normal atmospheric pressure which may produce physiological injury shall adhere to decompression schedules or other tables as are or may be adopted by the department of labor and industries: for example, state of Washington "safety standards for compressed air work" and "safety standards for commercial diving operations." The employer shall provide and supervise the use of decompression equipment and schedules in accordance with applicable requirements.

(2) If no specific requirements prevail for an unusual condition, a plan based on the recommendations of professionally qualified advisors, experienced with hazards associated with such exposures, shall be followed by both the employer and employee.
[Statutory Authority: Chapter 49.17 RCW. 91-11-070 (Order 91-01), 296-62-09007, filed 5/20/91, effective 6/20/91; Order 73-3, 296-62-09007, filed 5/7/73.]

WAC 296-62-09009 Vibration. Reasonable precautions shall be taken to protect workmen against the hazardous effects of unavoidable exposure to vibrations.
[Order 73-3, 296-62-09009, filed 5/7/73.]

WAC 296-62-09013 Temperature, radiant heat, or temperature-humidity combinations.

(1) Workmen subjected to temperature extremes, radiant heat, humidity, or air velocity combinations which, over a period of time, are likely to produce physiological responses which are harmful shall be afforded protection by use of adequate controls, methods or procedures, or protective clothing. This shall not be construed to apply to normal occupations under atmospheric conditions which may be expected in the area except that special provisions which are required by other regulations for certain areas or occupations shall prevail.
[Order 73-3, 296-62-09013, filed 5/7/73.]

PART K
HEARING CONSERVATION

WAC

WAC 296-62-09015 Hearing conservation. The employer shall administer a continuing effective hearing conservation program, as described in WAC 296-62-09015 through 296-62-09055 whenever employee noise exposures equal or exceed an 8-hour time-weighted average (TWA) sound level of 85 decibels (dB) measured on the A-scale weighting at slow response or, equivalently, a noise dose of fifty percent. For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with WAC 296-62-09055, Appendix E: Noise exposure computation, without regard to any attenuation provided by the use of personal protective equipment.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09015, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09015, filed 1/15/82.]

WAC 296-62-09017 Definitions. These definitions apply to the following terms as used in WAC 296-62-09015 through 296-62-09055.

(1) **Audiogram** - A chart, graph, or table resulting from an audiometric test showing an individual's hearing threshold levels as a function of frequency.

(2) **Audiologist** - A professional, specializing in the study and rehabilitation of hearing, who is certified by the American Speech, Hearing, and Language Association or licensed by a state board of examiners.

(3) **Baseline audiogram** - The audiogram against which future audiograms are compared.

(4) **Criterion sound level** - A sound level of 90 decibels.

(5) **Decibel (dB)** - Unit of measurement of sound level.

(6) **Hertz (Hz)** - Unit of measurement of frequency, numerically equal to cycles per second.

WAC 296-62-09017 (Cont.)

(7) **Impulsive or impact noise** - Noise levels which involve maxima at intervals greater than one second. Where the intervals are less than one second, the noise levels shall be considered continuous.

(8) **Medical pathology** - A disorder or disease. For purposes of this regulation, a condition or disease affecting the ear, which should be treated by a physician specialist.

(9) **Noise dose** - The ratio, expressed as a percentage, of (a) the time integral, over a stated time or event, of the 0.6 power of the measured slow exponential time-averaged, squared A-weighted sound pressure and (b) the product of the criterion duration (8 hours) and the 0.6 power of the squared sound pressure corresponding to the criterion sound level (90 dB).

(10) **Noise dosimeter** - An instrument that integrates a function of sound pressure over a period of time in such a manner that it directly indicates a noise dose.

(11) **Otolaryngologist** - A physician specializing in diagnosis and treatment of disorders of the ear, nose and throat.

(12) **Representative exposure** - Measurements of an employee's noise dose or 8-hour time-weighted average sound level that the employer deems to be representative of the exposure of other employees in the workplace.

(13) **Standard threshold shift** - A hearing level change, relative to the baseline audiogram, of an average of 10 dB or more at 2000, 3000, and 4000 Hz in either ear.

(14) **Sound level** - Ten times the common logarithm of the ratio of the the square of the measured A-weighted sound pressure to the square of the standard reference pressure of 20 micropascals. Unit: Decibels (dB). For use with this regulation, slow time response, in accordance with ANSI S1.4-1971 (R1976), is required unless specifically specified otherwise.

(15) **Sound level meter** - An instrument for the measurement of sound level.

(16) **Time-weighted average sound level** - That sound level, which if constant over an 8-hour period, would result in the same noise dose as if measured in the time varying noise level environment.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09017, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09017, filed 1/15/82.]

WAC 296-62-09019 Monitoring.

(1) When reasonable information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 dBA, the employer shall obtain individual or representative exposure measurements for all employees who may be exposed at or above that level.

(2) The sampling strategy shall be designed to identify all employees required to be included in the hearing conservation program and to enable the proper selection of hearing protectors.

(3) Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise exist, the employer shall use representative personal sampling to comply with the monitoring requirements of this section unless the employer can establish that area sampling produces equivalent results.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09019, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09019, filed 1/15/82.]

WAC 296-62-09021 Method of noise measurement.

(1) Noise dosimeters which comply, as a minimum, with the provisions of subdivision (1)(a) of this section or sound level meters which comply, as a minimum, with the provisions of subdivision (1)(b) of this section shall be used whenever employee exposures are evaluated for the purpose of complying with WAC 296-62-09015 through 296-62-09055.

(a) Dosimeters. Dosimeters shall meet the Class 2A-90/80-5 requirements of the American National Standard Specification for Personal Noise Dosimeters, S1.25-1978.

(b) Sound level meters. Sound level meters shall meet the Type 2 requirements of the American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976).

(2) All continuous, intermittent, and impulsive sound levels from 80 dBA to 130 dBA shall be integrated into the exposure computation.

(3) Monitoring shall be repeated whenever a change in production, process, equipment or controls increases noise exposures to the extent that:

(a) Additional employees may be exposed at or above an 8-hour time-weighted average of 85 dBA; or

(b) The attenuation provided by hearing protectors being used by employees may be rendered inadequate to meet the requirements of WAC 296-62-09033.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09021, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09021, filed 1/15/82.]

WAC 296-62-09023 Calibration of monitoring equipment. Dosimeters and sound level meters used to monitor employee noise exposure shall be calibrated using the instrument manufacturer's calibration instructions before and after each day's use.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09023, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09023, filed 1/15/82.]

WAC 296-62-09024 Employee notification. The employer shall notify each employee exposed at or above an 8-hour time-weighted average of 85 dBA of the results of the monitoring.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09024, filed 11/30/83.]

WAC 296-62-09025 Observation of monitoring. The employer shall provide affected employees or their representatives with an opportunity to observe any measurements of employee noise exposure which are conducted pursuant to WAC 296-62-09019.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 82-03-023 (Order 82-1), 296-62-09025, filed 1/15/82.]

WAC 296-62-09026 Noise control.

(1) Whenever employee noise exposures equal or exceed an 8-hour time-weighted average of 90 dBA, feasible administrative or engineering controls shall be utilized.

(2) Upon request, the employer shall prepare and submit a written compliance plan to the director or his/her designee. This plan must include a description of the manner in which compliance will be achieved with respect to cited violations of WAC 296-62-09026(1) and shall include proposed abatement methods, anticipated completion dates, and provision for progress reports to the director or his/her designee.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09026, filed 11/30/83.]

WAC 296-62-09027 Audiometric testing program.

(1) The employer shall establish and maintain a mandatory audiometric testing program as provided in this section for all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 dBA.

(2) The program shall be provided at no cost to employees.

(3) Audiometric tests shall be performed by a licensed or certified audiologist, otolaryngologist, or other qualified physician, or by a technician who is certified by the Council of Accreditation in Occupational Hearing Conservation. A technician who performs audiometric tests must be responsible to an audiologist, otolaryngologist or other qualified physician.

(4) All audiograms obtained pursuant to this section shall meet the requirements of WAC 296-62-09047, Appendix A: Audiometric measuring instruments.

(5) **Baseline audiogram.**

(a) Prior to or within 180 days after an employee's first exposure to noise at or above a time-weighted average of 85 dBA, the employer shall establish for each employee so exposed a valid baseline audiogram against which subsequent audiograms can be compared. Employers who utilize mobile test units are allowed up to one year to obtain a valid baseline audiogram for each exposed employee, provided that each employee so exposed shall be trained and shall wear suitable hearing protectors in accordance with WAC 296-62-09015 through 296-62-09055.

(b) Testing to establish a baseline audiogram shall be preceded by at least 14 hours without exposure to workplace noise.

This may be accomplished by use of hearing protectors; however, the employer shall notify employees of the need to avoid high levels of nonoccupational noise exposure during the 14-hour period immediately preceding the audiometric examination.

(6) **Annual audiogram.**

(a) At least annually (i.e. every 12-month interval) after obtaining the baseline audiogram, the employer shall obtain a new audiogram for each employee exposed at or above a time-weighted average of 85 dBA.

(b) Annual audiometric testing may be conducted at any time during the workshift.

(7) **Evaluation of audiogram.**

(a) Each employee's annual audiogram shall be compared to that employee's baseline audiogram to determine if a standard threshold shift has occurred. This comparison may be made by a certified audiometric technician.

(b) If the annual audiogram indicates that an employee has suffered a standard threshold shift, the employer may obtain a retest within 30 days and consider the results of the retest as the annual audiogram.

(c) An audiologist, otolaryngologist or other qualified physician shall review audiograms which indicate a standard threshold shift to determine whether there is need for further evaluation. The employer shall provide to the person performing this evaluation the following information:

WAC 296-62-09027 (Cont.)

(i) A copy of the requirements for hearing conservation as set forth in WAC 296-62-09015 through 296-62-09055;

(ii) The baseline audiogram and most recent audiogram of the employee to be evaluated;

(iii) Measurements of background sound pressure levels in the audiometric test room as required in WAC 296-62-09049, Appendix B: Audiometric test rooms; and

(iv) Records of audiometer calibrations required by WAC 296-62-09029(5).

(d) Inform each employee of the results of his/her audiometric test and whether or not there has been a hearing level decrease or improvement since his/her previous test.

(8) **Follow-up procedures.** If a comparison of the annual audiogram to the baseline audiogram indicates a standard threshold shift, the employer shall ensure that the following steps are taken:

(a) Employees not using hearing protectors shall be fitted with hearing protectors, trained in their use and care, and required to use them.

(b) Employees already using hearing protectors shall be refitted and retrained in the use of hearing protectors and provided with hearing protectors offering greater attenuation if necessary.

(c) Inform the employee in writing, within 21 days of the determination, of the existence of a standard threshold shift;

(d) Refer the employee, at no cost to the employee, for a clinical audiological evaluation or an otological examination, as appropriate, if additional testing is necessary or if the employer suspects that a medical pathology of the ear (as defined in WAC 296-62-09017) is caused or aggravated by the wearing of hearing protectors; and

(e) Inform the employee of the need for an otological examination if a medical pathology of the ear which is unrelated to the use of hearing protectors is suspected.

(9) **Revised baseline.** An annual audiogram may be substituted for the baseline audiogram when, in the judgment of the audiologist, otolaryngologist or other qualified physician who is evaluating the audiogram:

(a) The standard threshold shift revealed by the audiogram is persistent; or

(b) The hearing threshold shown in the annual audiogram indicates significant improvement over the baseline audiogram.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09027, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09027, filed 1/15/82.]

WAC 296-62-09029 Audiometric test requirements.

(1) Audiometric tests shall be pure tone, air conduction, hearing threshold examinations, with test frequencies including as a minimum 500, 1000, 2000, 3000, 4000, and 6000 Hz. Tests at each frequency shall be taken separately for each ear.

(2) Audiometric tests shall be conducted with audiometers (including microprocessor audiometers) that meet the specifications of, and are maintained and used in accordance with, American National Standard Specification for Audiometers, S3.6-1969(R1973).

WAC 296-62-09029 (Cont.)

(3) Pulsed-tone and self-recording audiometers, if used, shall meet the requirements specified in WAC 296-62-09047, Appendix A: Audiometric measuring instruments.

(4) Audiometric examinations shall be administered in a room meeting the requirements listed in WAC 296-62-09049, Appendix B: Audiometric test rooms.

(5) **Audiometer calibration.**

(a) The functional operation of the audiometer shall be checked before each day's use by testing a person with known, stable hearing thresholds, and by listening to the audiometer's output to make sure that the output is free from distorted or unwanted sounds. Deviations of 10 dB or greater shall require an acoustic calibration.

(b) Audiometer calibration shall be checked acoustically at least annually in accordance with WAC 296-62-09051, Appendix C: Acoustic calibration of audiometers. Test frequencies below 500 Hz and above 6000 Hz may be omitted from this check.

(c) An exhaustive calibration shall be performed at least every two years in accordance with sections 4.1.2; 4.1.3; 4.1.4.3; 4.2; 4.4.1; 4.4.2; 4.4.3; and 4.5 of the American National Standard Specification for Audiometers, S3.6-1969(R1973). Test frequencies below 500 Hz and above 6000 Hz may be omitted from the calibration.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09029, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09029, filed 1/15/82.]

WAC 296-62-09031 Hearing protectors.

(1) Employers shall make hearing protectors available to all employees exposed to a time-weighted average of 85 dBA or greater at no cost to the employees. Hearing protectors shall be replaced as necessary.

(2) Employers shall ensure that hearing protectors are worn:

(a) By any employee who is exposed to an 8-hour time-weighted average of 85 dBA or greater; or

(b) By any employee who is exposed to noise above 115 dBA; or

(c) By any employee who is exposed to any impulsive or impact noise measured at or above 140 dB peak using an impulse sound level meter set to either the linear or C-scale.

(3) Employees shall be given the opportunity to select their hearing protectors from at least two different types (i.e. molded, self-molded, custom molded, or ear muffs) of suitable hearing protectors provided by the employer.

(4) The employer shall provide training in the use and care of all hearing protectors provided to employees.

(5) The employer shall ensure proper initial fitting and supervise the correct use of all hearing protectors.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09031, filed 11/30/83; 82-13-045 (Order 82-22), 296-62-09031, filed 6/11/82; 82-03-023 (Order 82-1), 296-62-09031, filed 1/15/82.]

WAC 296-62-09033 Hearing protector attenuation.

(1) The employer shall evaluate hearing protector attenuation for the specific noise environments in which the protector will be used by one of the methods described in WAC 296-62-09053, Appendix D: Methods for estimating the adequacy of hearing protector attenuation, or by other methods if approved by the director.

WAC 296-62-09033 (Cont.)

(2) Hearing protectors must attenuate employee exposure at least to a time-weighted average of 85 dBA or below.

(3) The adequacy of hearing protector attenuation shall be re-evaluated whenever employee noise exposures increase to the extent that the hearing protectors provided may no longer provide adequate attenuation. The employer shall provide more effective hearing protectors where necessary.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09033, filed 11/30/83; 82-13-045 (Order 82-22), 296-62-09033, filed 6/11/82; 82-03-023 (Order 82-1), 296-62-09033, filed 1/15/82.]

WAC 296-62-09035 Training program.

(1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 dBA, and shall ensure employee participation in such program.

(2) The training program shall be repeated annually for each employee included in the hearing conservation program. Information provided in the training program shall be updated to be consistent with changes in protective equipment and work processes.

(3) The employer shall ensure that each employee is informed of the following:

(a) The effects of noise on hearing;

(b) The purpose of hearing protectors, the advantages, disadvantages, and attenuation of various types, and instructions on selection, fitting, use, and care; and

(c) The purpose of audiometric testing, and an explanation of the test procedures.

(d) The right to access to records as specified in WAC 296-62-09041(5).

(4) A written description of the training program instituted shall be maintained by each employer.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09035, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09035, filed 1/15/82.]

WAC 296-62-09037 Access to information and training materials.

(1) The employer shall make available to affected employees or their representatives copies of this standard and shall also post a copy in the workplace.

(2) The employer shall provide to affected employees any informational materials pertaining to this standard that are supplied to the employer by the director.

(3) The employer shall provide, upon request, all materials related to the employer's training and education program pertaining to this standard to the director.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 82-03-023 (Order 82-1), 296-62-09037, filed 1/15/82.]

WAC 296-62-09039 Warning signs.

(1) Signs shall be posted at entrances to or on the periphery of all well defined work areas in which employees may be exposed at or above 115 dBA.

(2) Warning signs shall clearly indicate that the area is a high noise area and that hearing protectors are required.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09039, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09039, filed 1/15/82.]

WAC 296-62-09041 Recordkeeping.

(1) **Exposure measurements.** The employer shall maintain an accurate record of all employee exposure measurements required by this section.

(2) **Audiometric tests.**

(a) The employer shall retain a legible copy of all employee audiograms obtained pursuant to WAC 296-62-09027.

(b) This record shall include:

(i) Name and job classification of the employee;

(ii) Date of the audiogram;

(iii) The examiner's name;

(iv) Date of the last acoustic or exhaustive calibration of the audiometer; and

(v) Employee's most recent noise exposure assessment.

(3) **Audiometric test rooms.** The employer shall maintain accurate records of the measurements of the background sound pressure levels in audiometric test rooms.

(4) **Record retention.** The employer shall retain records required in this section for at least the following periods:

(a) Noise exposure measurement records shall be retained for two years.

(b) Audiometric test records shall be retained for the duration of the affected employee's employment.

(5) **Access to records.** All records required by this section shall be provided upon request to employees, former employees, representatives designated by the individual employee, and the director. The provisions of WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217 apply to access to records under this section.

(6) **Transfer of records.** If the employer ceases to do business, the employer shall transfer to the successor employer all records required to be maintained by this section, and the successor employer shall retain them for the remainder of the period prescribed in WAC 296-62-09041(4).

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09041, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09041, filed 1/15/82.]

WAC 296-62-09043 Appendices. WAC 296-62-09047, 296-62-09049, 296-62-09051, and 296-62-09053 and 296-62-09055, Appendices A, B, C, D, and E are incorporated as part of this section and the contents of these appendices are mandatory.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09043, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09043, filed 1/15/82.]

WAC 296-62-09045 Effective dates.

(1) WAC 296-62-09015 through 296-62-09053 shall become effective 60 days after filing with the code reviser, unless otherwise noted below.

(2) Monitoring conducted pursuant to WAC 296-62-09019 shall be completed no later than 180 days from the effective date of the standard.

WAC 296-62-09045 (Cont.)

(3) Baseline audiograms required by WAC 296-62-09027 shall be completed no later than December 31, 1982.
[Statutory Authority: RCW 49.17.040 and 49.17.050. 82-03-023 (Order 82-1), 296-62-09045, filed 1/15/82.]

WAC 296-62-09047 Appendix A--Audiometric measuring instruments.

(1) In the event that pulsed-tone audiometers are used, they shall have a tone on-time of at least 200 milliseconds.

(2) Self-recording audiometers shall comply with the following requirements:

(a) The chart upon which the audiogram is traced shall have lines at positions corresponding to all multiples of 10 dB hearing level within the intensity range spanned by the audiometer. The lines shall be equally spaced and shall be separated by at least 1/4 inch. Additional increments are optional. The audiogram pen tracings shall not exceed 2 dB in width.

(b) It shall be possible to set the stylus manually at the 10dB increment lines for calibration purposes.

(c) The slewing rate for the audiometer attenuator shall not be more than 6 dB/sec except that an initial slewing rate greater than 6 dB/sec is permitted at the beginning of each new test frequency, but only until the second subject response.

(d) The audiometer shall remain at each required test frequency for 30 seconds (±3 seconds). The audiogram shall be clearly marked at each change of frequency and the actual frequency change of the audiometer shall not deviate from the frequency boundaries marked on the audiogram by more than ±3 seconds.

(e) It must be possible at each test frequency to place a horizontal line segment parallel to the time axis on the audiogram, such that the audiometric tracing crosses the line segment at least six times at the test frequency. At each test frequency the threshold shall be the average of the midpoints of the tracing excursions.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09047, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09047, filed 1/15/82.]

WAC 296-62-09049 Appendix B--Audiometric test rooms. Rooms used for audiometric testing shall not have background sound pressure levels exceeding those in Table B-1 when measured by equipment conforming at least to the Type 2 requirements of American National Standard Specification for Sound Level Meters, S1.4-1971 (R1976), and to the Class II requirements of American National Standard Specification for Octave, Half-Octave, and Third-Octave Band Filter Sets, S1.11-1971 (R1976).

TABLE B-1

Maximum Allowable Octave Band Sound Pressure Levels for Audiometric Test Rooms

Octave band center Frequency (Hz)	500	1000	2000	4000	8000
Sound pressure level (dB)	40	40	47	57	62

[Statutory Authority: RCW 49.17.040 and 49.17.050. 82-03-023 (Order 82-1), 296-62-09049, filed 1/15/82.]

WAC 296-62-09051 Appendix C--Acoustic calibration of audiometers. Audiometer calibration shall be checked acoustically, at least annually, according to the procedures described in this Appendix. The equipment necessary to perform these measurements is a sound level meter, octave-band filter set, and a National Bureau of Standards 9A coupler. In making these measurements, the accuracy of the calibrating equipment shall be sufficient to determine that the audiometer is within the tolerance permitted by American National Standard Specifications for Audiometers, S3.6-1969(R1973).

(1) **Sound pressure output check.**

(a) Place the earphone coupler over the microphone of the sound level meter and place the earphone on the coupler.

(b) Set the audiometer's hearing threshold level (HTL) dial to 70 dB.

(c) Measure the sound pressure level of the tones at each test frequency from 500 Hz through 6000 Hz for each earphone.

(d) At each frequency the readout on the sound level meter should correspond to the levels in Table C-1 or Table C-2, as appropriate, for the type of earphone, in the column entitled “sound level meter reading.”

(2) **Linearity check.**

(a) With the earphone in place, set the frequency to 1000 Hz and the HTL dial on the audiometer to 70 dB.

(b) Measure the sound levels in the coupler at each 10dB decrement from 70 dB to 10 dB, noting the sound level meter reading at each setting.

(c) For each 10dB decrement on the audiometer the sound level meter should indicate a corresponding 10 dB decrease.

(d) This measurement may be made electrically with a voltmeter connected to the earphone terminals.

(3) **Tolerances.**

When any of the measured sound levels deviate from the levels in Table C-1 or Table C-2 by ±3 dB at any test frequency between 500 and 3000 Hz, 4 dB at 4000 Hz, or 5 dB at 6000 Hz, an exhaustive calibration is required.

Table C-1

Reference threshold levels for telephonics - TDH 39 earphones

Frequency, Hz	Reference Threshold level For TDH-39 Earphones , dB	Sound level Meter reading, dB
500	11.5	81.5
1000	7	77
2000	9	79
3000	10	80
4000	9.5	79.5
6000	15.5	85.5

WAC 296-62-09051 (Cont.)

Table C-2		
Reference threshold levels for telephonics - TDH 49 earphones		
Frequency, Hz	**Reference Threshold level For TDH-49 Earphones, dB**	**Sound level Meter reading, dB**
500	13.5	83.5
1000	7.5	77.5
2000	11	81.0
3000	9.5	79.5
4000	10.5	80.5
6000	13.5	83.5

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09051, filed 11/30/83; 82-13-045 (Order 82-22), 296-62-09051, filed 6/11/82; 82-03-023 (Order 82-1), 296-62-09051, filed 1/15/82.]

WAC 296-62-09053 Appendix D--Methods for estimating the adequacy of hearing protector attenuation.

(1) Hearing protector attenuation must be sufficient to reduce employee exposure to a TWA of 85 dBA.

(2) The most convenient method to use is the noise reduction rating (NRR) developed by the Environmental Protection Agency (EPA). According to EPA regulation, the NRR must be shown on the hearing protector package. The NRR is then related to an individual worker's noise environment in order to assess the adequacy of the attenuation of a given hearing protector. This appendix describes two methods of using the NRR to determine whether a particular hearing protector provides adequate protection within a given exposure environment. Selection between the two procedures is dependent upon the employer's noise measuring instruments.

(3) When using the NRR to assess hearing protector adequacy, one of the following methods must be used:

(a) When using a dosimeter that is capable of making A-weighted measurements:

(i) Convert the A-weighted dose to TWA.

(ii) Subtract 7 dB from the NRR.

(iii) Subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(b) When using a sound level meter set to the A-weighting network:

(i) Obtain the employee's A-weighted TWA.

(ii) Subtract 7 dB from the NRR, and subtract the remainder from the A-weighted TWA to obtain the estimated A-weighted TWA under the ear protector.

(4) Other methods may be utilized if they are at least as effective as the NRR if approved by the director.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09053, filed 11/30/83; 82-03-023 (Order 82-1), 296-62-09053, filed 1/15/82.]

WAC 296-62-09055 Appendix E--Noise exposure computation.

(1) **Computation of employee noise exposure.**

(a) Noise dose is computed using Table E-1 as follows:

(i) When the sound level, L, is constant over the entire work shift, the noise dose, D, in percent, is given by: D=100 C/T where C is the total length of the work day, in hours, and T is the reference duration corresponding to the measured sound level, L, as given in Table E-1 or by the formula shown as a footnote to that table.

(ii) When the workshift noise exposure is composed of two or more periods of noise at different levels, the total noise dose over the work day is given by: $D=100(C_1/T_1+C_2/T_2+...+C_nT_n)$, where C_n indicates the total time of exposure at a specific noise level, and Tn indicates the reference duration for that level as given by Table E-1.

(b) The 8-hour time-weighted average sound level (TWA), in decibels, may be computed from the dose, in percent, by means of the formula: $TWA = 16.61 \log_{10}(D/100)+90$. For an 8-hour workshift with the noise level constant over the entire shift, the TWA is equal to the measured sound level.

(c) A table relating dose and TWA is given in subsection (2) of this section.

Table E-1

A weighted sound level, L (decibel)	Reference duration T (hour)
80	32
81	27.9
82	24.3
83	21.1
84	18.4
85	16
86	13.9
87	12.1
88	10.6
89	9.2
90	8
91	7.0
92	6.2
93	5.3
94	4.6
95	4
96	3.5
97	3.0
98	2.6
99	2.3
100	2
101	1.7
102	1.5
103	1.4
104	1.3

WAC 296-62-09055 (Cont.)

Table E-1 (Cont.)	
A weighted sound level, L (decibel)	**Reference duration T (hour)**
105	1
106	0.87
107	0.76
108	0.66
109	0.57
110	0.5
111	0.44
112	0.38
113	0.33
114	0.29
115	0.25
116	0.22
117	0.19
118	0.16
119	0.14
120	0.125
121	0.11
122	0.095
123	0.082
124	0.072
125	0.063
126	0.054
127	0.047
128	0.041
129	0.036
130	0.031

In the above table the reference duration T, is computed by

$$T = \frac{8}{2^{(L-90)/5}}$$

where L is the measured A-weighted sound level.

(2) **Conversion between "dose" and "8-hour time-weighted average" sound level.**

(a) Compliance with WAC 296-62-09015 through 296-62-09055 of this regulation is determined by the amount of exposure to noise in the workplace. The amount of such exposure is usually measured with an audiodosimeter which gives a readout in terms of "dose." In order to better understand the requirements of these standards, dosimeter readings can be converted to an "8-hour time-weighted average (TWA) sound level."

WAC 296-62-09055 (Cont.)

(b) In order to convert the reading of a dosimeter into TWA, see Table E-2. This table applies to dosimeters that are set by the manufacturer to calculate dose or percent exposure according to the relationships in Table E-1. So, for example, a dose of 91 percent over an eight-hour day results in a TWA of 89.3 dB, and a dose of 50 percent corresponds to a TWA of 85 dB.

(c) If the dose as read on the dosimeter is less than or greater than the values found in Table E-2, the TWA may be calculated by using the formula: TWA = 16.61 log10 (D/100) + 90 where TWA = 8-hour time-weighted average sound level and D = accumulated dose in percent exposure.

Table E-2

Conversion from "percent noise exposure" or "dose" To "8-hour time weighted average sound level" (TWA)

Dose or percent noise exposure	TWA (dBA)
10	73.4
15	76.3
20	78.4
25	80.0
30	81.3
35	82.4
40	83.2
45	84.2
50	85.0
55	85.7
60	86.3
65	86.9
70	87.4
75	87.9
80	88.4
81	88.5
82	88.6
83	88.7
84	88.7
85	88.8
86	88.9
87	89.0
88	89.1
89	89.2
90	89.2
91	89.3
92	89.4
93	89.5
94	89.6
95	89.6
96	89.7
97	89.8
98	89.9
99	89.9
100	90.0
101	90.1
102	90.1
103	90.2

WAC 296-62-09055 (Cont.)

Table E-2 (Cont.)	
Conversion from "percent noise exposure" or "dose" To "8-hour time weighted average sound level" (TWA)	
Dose or percent noise exposure	**TWA (dBA)**
104	90.3
105	90.4
106	90.4
107	90.5
108	90.6
109	90.6
110	90.7
111	90.8
112	90.8
113	90.9
114	90.9
115	91.1
116	91.1
117	91.1
118	91.2
119	91.3
120	91.3
125	91.6
130	91.9
135	.92.2
140	92.4
145	92.7
150	92.9
155	93.2
160	93.4
165	93.6
170	93.8
175	94.0
180	94.2
185	94.4
190	94.6
195	94.8
200	95.0
210	95.4
220	95.7
230	96.0
240	96.3
250	96.6
260	96.9
270	97.2
280	97.4
290	97.7
300	97.9
310	98.2
320	98.4
330	98.6
340	98.8

WAC 296-62-09055 (Cont.)

Table E-2 (Cont.)	
Conversion from "percent noise exposure" or "dose" To "8-hour time weighted average sound level" (TWA)	
Dose or percent noise exposure	**TWA (dBA)**
350	99.0
360	99.2
370	99.4
380	99.6
390	99.8
400	100.0
410	100.2
420	100.4
430	100.5
440	100.7
450	100.8
460	101.0
470	101.2
480	101.3
490	101.5
500	101.6
510	101.8
520	101.9
530	102.0
540	102.2
550	102.3
560	102.4
570	102.6
580	102.7
590	102.8
600	102.9
610	103.0
620	103.2
630	103.3
640	103.4
650	103.5
660	103.6
670	103.7
680	103.8
690	103.9
700	104.0
710	104.1
720	104.2
730	104.3
740	104.4
750	104.5
760	104.6
770	104.7
780	104.8
790	104.9
800	105.0
810	105.1

WAC 296-62-09055 (Cont.)

Table E-2 (Cont.)	
Conversion from "percent noise exposure" or "dose" To "8-hour time weighted average sound level" (TWA)	
Dose or percent noise exposure	**TWA (dBA)**
820	105.2
830	105.3
840	105.4
850	105.4
860	105.5
870	105.6
880	105.7
890	105.8
900	105.8
910	105.9
920	106.0
930	106.1
940	106.2
950	106.2
960	106.3
970	106.4
980	106.5
990	106.5
999	106.6

[Statutory Authority: RCW 49.17.040 and 49.17.050. 83-24-013 (Order 83-34), 296-62-09055, filed 11/30/83.]

PART L
ATMOSPHERES, VENTILATION, EMERGENCY WASHINGS

WAC

WAC 296-62-100 Oxygen deficient atmospheres.

(1) **Definition.** A lack of sufficient oxygen is deemed to exist if the atmosphere at sea level has less than 19.5% oxygen by volume or has a partial pressure of oxygen of 148 millimeters of mercury (mm. Hg) or less. This may deviate when working at higher elevations and should be determined for an individual location. Factors such as acclimatization, physical conditions of the persons involved, etc., must be considered for such circumstances and conditions.

(2) **Entering areas with possible oxygen deficient atmospheres.** Workers entering any area where a lack of sufficient oxygen is probable shall be supplied with and shall use approved equipment (for specific requirements see applicable provisions of chapter 296-62 WAC) capable of providing safe respirable air, or prior to entry and at all times when workers are in such areas a sufficient supply of safe, respirable air shall be provided. All workers so exposed shall be under constant observation. If the oxygen content is unknown or may change during occupation, tests shall be required prior to and during occupation of questionable areas.

[Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), 296-62-100, filed 11/22/91, effective 12/24/91. RCW 49.17.040, 49.17.050, and 49.17.240. 81-16-015 (Order 81-20), 296-62-100, filed 7/27/81; Order 73-3, 296-62-100, filed 5/7/73; Order 70-8, 296-62-100, filed 7/31/70, effective 9/1/70; Rule 10.010, effective 8/1/63.]

WAC 296-62-110 Ventilation.

[Order 73-3, 296-62-110, filed 5/7/73; Order 70-8, 296-62-110, filed 7/31/70, effective 9/1/70; Rules 11.010-11.030, effective 8/1/63.]

WAC 296-62-11001 Definition. Ventilation shall mean the provision, circulation or exhausting of air into or from an area or space.

(1) **"Local exhaust ventilation"** shall mean the mechanical removal of contaminated air from the point where the contaminant is being generated or liberated.

(2) **"Dilution ventilation"** means inducing and mixing uncontaminated air with contaminated air in such quantities that the resultant mixture in the breathing zone will not exceed the permissible exposure limit (PEL) specified for any contaminant.

WAC 296-62-11001 (Cont.)

(3) **"Exhaust ventilation"** means the general movement of air out of the area or permit-required confined space by mechanical or natural means.

(4) **"Tempered makeup air"** means air which has been conditioned by changing its heat content to obtain a specific desired temperature.

[Statutory Authority: Chapter 49.17 RCW. 95-04-007, 296-62-11001, filed 1/18/95, effective 3/1/95. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), 296-62-11001, filed 11/13/80; Order 73-3, 296-62-11001, filed 5/7/73.]

WAC 296-62-11003 Ventilation guide. In addition to those mandatory controls as set forth in WAC 296-62-11015 through 296-62-11021, the Industrial Ventilation Manual of Recommended Practices as compiled and approved by the American Conference of Governmental Industrial Hygienists, applicable ANSI Standard or other National Consensus Standards recommended by the federal government, should be used as a guide for ventilation requirements.

[Order 73-3, 296-62-11003, filed 5/7/73.]

WAC 296-62-11005 Adequate system. Adequate ventilation systems shall be installed as needed to control concentrations of airborne contaminants below applicable threshold limit values.

[Order 73-3, 296-62-11005, filed 5/7/73.]

WAC 296-62-11007 Exhaust. Exhaust from ventilation systems shall discharge in such a manner that the contaminated air being exhausted will not present a health hazard to any workman or reenter buildings in harmful amounts.

[Order 73-3, 296-62-11007, filed 5/7/73.]

WAC 296-62-11009 Make-up air quantity. Make-up air shall be of ample quantity to replace the exhausted air and shall be tempered when necessary.

[Order 73-3, 296-62-11009, filed 5/7/73.]

WAC 296-62-11011 Design and operation. Ventilation systems shall be designed and operated in such a manner that employees will not be subjected to excessive air velocities.

[Statutory Authority: Chapter 49.17 RCW. 91-11-070 (Order 91-01), 296-62-11011, filed 5/20/91, effective 6/20/91; Order 73-3, 296-62-11011, filed 5/7/73.]

WAC 296-62-11013 Compatibility of systems. Make-up air systems shall be designed and operated in such a manner that they will not interfere with the effectiveness of the exhaust air system.

[Order 73-3, 296-62-11013, filed 5/7/73.]

WAC 296-62-11015 Abrasive blasting. Abrasive blasting is covered in the General safety and health standards WAC 296-24-675, Safe practices of abrasive blasting operations (Part H-2).

[Statutory Authority: RCW 49.17.040, [49.17].050 and [49.17].060. 98-02-006, 296-62-11015, filed 12/26/97, effective 3/1/98. Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), 296-62-11015, filed 11/22/91, effective 12/24/91. RCW 49.17.040, 49.17.050, and 49.17.240. 81-16-015 (Order 81-20), 296-62-11015, filed 7/27/81; 80-11-010 (Order 80-14), 296-62-11015, filed 8/8/80; Order 73-3, 296-62-11015, filed 5/7/73.]

WAC 296-62-11017 Grinding, polishing, and buffing operations.

(1) **Definitions.**

(a) **"Abrasive cutting-off wheels"** means organic-bonded wheels, the thickness of which is not more than one forty-eighth of their diameter for those up to, and including, 20 inches in diameter, and not more than one-sixteenth of their diameter for those larger than 20 inches in diameter, used for a multitude of operations variously known as cutting, cutting off, grooving, slotting, coping, jointing, and the like. The wheels may be "solid" consisting of organic-bonded abrasive material throughout, "steel centered" consisting of a steel disc with a rim of organic-bonded material moulded around the periphery or of the "inserted tooth" type consisting of a steel disc with organic-bonded abrasive teeth or inserts mechanically secured around the periphery.

(b) **"Belts"** means all power-driven, flexible, coated bands used for grinding, polishing, or buffing purposes.

WAC 296-62-11017 (Cont.)

(c) **"Branch pipe"** means the part of an exhaust system piping that is connected directly to the hood or enclosure.

(d) **"Cradle"** means a movable fixture, upon which the part to be ground or polished is placed.

(e) **"Disc wheels"** means all power-driven rotatable discs faces with abrasive materials, artificial or natural, and used for grinding or polishing on the side of the assembled disc.

(f) **"Entry loss"** means the loss in static pressure caused by air flowing into a duct or hood. It is usually expressed in inches of water gauge.

(g) **"Exhaust system"** means a system consisting of branch pipes connected to hoods of enclosures, one or more header pipes, an exhaust fan, means for separating solid contaminants from the air flowing in the system, and a discharge stack to outside.

(h) **"Grinding wheels"** means all power-driven rotatable grinding or abrasive wheels, except disc wheels as defined in this standard, consisting of abrasive particles held together by artificial or natural bonds and used for peripheral grinding.

(i) **"Header pipe (main pipe)"** means a pipe into which one or more branch pipes enter and which connects such branch pipes to the remainder of the exhaust system.

(j) **"Hoods and enclosures"** means the partial or complete enclosure around the wheel or disc through which air enters an exhaust system during operation.

(k) **"Horizontal double-spindle disc grinder"** means a grinding machine carrying two power-driven, rotatable, coaxial, horizontal spindles upon the inside ends of which are mounted abrasive disc wheels for grinding two surfaces simultaneously.

(l) **"Horizontal single-spindle disc grinder"** means a grinding machine carrying an abrasive disc wheel upon one or both ends of a power-driven, rotatable single horizontal spindle.

(m) **"Polishing and buffing wheels"** means all power-driven rotatable wheels composed all or in part of textile fabrics, wood, felt, leather, paper, and may be coated with abrasives on the periphery of the wheel for purposes of polishing, buffing, and light grinding.

(n) **"Portable grinder"** means any power-driven rotatable grinding, polishing, or buffing wheel mounted in such manner that it may be manually manipulated.

(o) **"Scratch brush wheels"** means all power-driven rotatable wheels made from wire or bristles, and used for scratch cleaning and brushing purposes.

(p) **"Swing-frame grinder"** means any power-driven rotatable grinding, polishing, or buffing wheel mounted in such a manner that the wheel with its supporting framework can be manipulated over stationary objects.

(q) **"Velocity pressure (vp)"** means the kinetic pressure in the direction of flow necessary to cause a fluid at rest to flow at a given velocity. It is usually expressed in inches of water gauge.

(r) **"Vertical spindle disc grinder"** means a grinding machine having a vertical, rotatable power-driven spindle carrying a horizontal abrasive disc wheel.

WAC 296-62-11017 (Cont.)

(2) **Application.**

(a) Every establishment performing dry grinding, dry polishing, or buffing shall provide suitable hood or enclosures that are connected to exhaust systems.

(b) Such exhaust systems shall be operated continuously whenever such operations are carried on, and be capable of preventing contaminants from entering the breathing zone.

(3) **Hood and branch pipe requirements.**

(a) Hoods connected to exhaust systems shall be used, and such hoods shall be designed, located, and placed so that the dust or dirt particles shall fall or be projected into the hoods in the direction of the air flow. No wheels, discs, straps, or belts shall be operated in such manner and in such direction as to cause the dust and dirt particles to be thrown into the operator's breathing zone.

(b) Grinding wheels on floor stands, pedestals, benches, and special-purpose grinding machines and abrasive cutting-off wheels shall have not less than the minimum exhaust volumes shown in Table 8 with a recommended minimum duct velocity of 4,500 feet per minute in the branch and 3,500 feet per minute in the main. The entry losses from all hoods except the vertical-spindle disc grinder hood, shall equal 0.65 velocity pressure for a straight takeoff and 0.45 velocity pressure for a tapered takeoff. The entry loss for the vertical-spindle disc grinder hood is shown in Figure 3. (See Fig. 3 following this section.)

TABLE 8
GRINDING AND ABRASIVE CUTTING

Wheel diameter (inches)	Wheel width (inches)	Minimum exhaust volume (feet ^{3}/min.)
To 9	1 1/2	220
Over 9 to 16	2	390
Over 16 to 19	3	500
Over 19 to 24	4	610
Over 24 to 30	5	880
Over 30 to 36	6	1,200

For any wheel wider than wheel diameter shown in Table 8, increase the exhaust volume by the ratio of the new width to the width shown.

Example:

If wheel width = 4 1/2 inches, then

$$\frac{4.5}{4} \times 610 = 686 \text{ (rounded to 690).}$$

(c) Scratch-brush wheels and all buffing and polishing wheels mounted on floor stands, pedestals, benches, or special-purpose machines shall have not less than the minimum exhaust volume shown in Table 9.

WAC 296-62-11017 (Cont.)

TABLE 9 BUFFING AND POLISHING WHEELS		
Wheel diameter (inches)	**Wheel width (inches)**	**Minimum exhaust volume (feet ^{3}/min.)**
To 9	2	300
Over 9 to 16	3	500
Over 16 to 19	4	610
Over 19 to 24	5	740
Over 24 to 30	6	1,040
Over 30 to 36	6	1,200

(d) Grinding wheels or discs for horizontal single-spindle disc grinders shall be hooded to collect the dust or dirt generated by the grinding operation and the hoods shall be connected to branch pipes having exhaust volumes as shown in Table 10.

TABLE 10 HORIZONTAL SINGLE-SPINDLE DISC GRINDER	
Disc diameter (inches)	**Exhaust volume (feet^3/min.)**
Up to 12	220
Over 12 to 19	390
Over 19 to 30	610
Over 30 to 36	880

(e) Grinding wheels or discs for horizontal double-spindle disc grinders shall have a hood enclosing the grinding chamber and the hood shall be connected to one or more branch pipes having exhaust volumes as shown in Table 11.

TABLE 11 HORIZONTAL DOUBLE-SPINDLE DISC GRINDER	
Disc diameter (inches)	**Exhaust volume (feet^3/min.)**
Up to 19	610
Over 19 to 25	880
Over 25 to 30	1,200
Over 30 to 53	1,770
Over 53 to 72	6,280

(f) Grinding wheels or discs for vertical single-spindle disc grinders shall be encircled with hoods to remove the dust generated in the operation. The hoods shall be connected to one or more branch pipes having exhaust volumes as shown in Table 12.

TABLE 12 VERTICAL SPINDLE DISC GRINDER				
Disc diameter (inches)	**One-half or more of disc covered**		**Disc not covered**	
	Number[1]	**Exhaust feet^3/min**	**Number[1]**	**Exhaust feet^3/min**
Up to 20	1	500	2	780
Over 20 to 30	2	780	2	1,480
Over 30 to 53	2	1,770	4	3,530
Over 53 to 72	2	3,140	5	6,010

WAC 296-62-11017 (Cont.)

[1] Number of exhaust outlets around periphery of hood, or equal distribution provided by other means.

(g) Grinding and polishing belts shall be provided with hoods to remove dust and dirt generated in the operations and the hoods shall be connected to branch pipes having exhaust volumes as shown in Table 13.

TABLE 13
GRINDING AND POLISHING BELTS

Belts width (inches)	Exhaust volume ($feet^3$/min.)
Up to 3	220
Over 3 to 5	300
Over 5 to 7	390
Over 7 to 9	500
Over 9to 11	610
Over 11 to 13	740

(h) Cradles and swing-frame grinders. Where cradles are used for handling the parts to be ground, polished, or buffed, requiring large partial enclosures to house the complete operation, a minimum average air velocity of 150 feet per minute shall be maintained over the entire opening of the enclosure. Swing-frame grinders shall also be exhausted in the same manner as provided for cradles. (See Fig. 5 following this section.)

(i) Where the work is outside the hood, air volumes must be increased as shown in American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960 (Section 4, Exhaust Hoods).

(4) **Exhaust systems.**

(a) Exhaust systems for grinding, polishing, and buffing operations should be designed in accordance with American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(b) Exhaust systems for grinding, polishing, and buffing operations shall be tested in the manner described in American Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(c) All exhaust systems shall be provided with suitable dust collectors.

(5) **Hood and enclosure design.**

(a)(i) It is the dual function of grinding and abrasive cutting-off wheel hoods to protect the operator from the hazards of bursting wheels as well as to provide a means for the removal of dust and dirt generated. All hoods shall be not less in structural strength than specified in the American National Standard Code for the Use, Care, and Protection of Abrasive Wheels, B7.1-1970.

(ii) For grinding machines for which no standard hoods are available, hoods meeting the requirements of (5)(a)(i) above shall be developed and so located so as to comply with the requirements of this section.

(b) Exhaust hoods for floor stands, pedestals, and bench grinders shall be designed in accordance with Figure 4. (See Fig. 4 following this section.) The adjustable tongue shown in the figure

shall be kept in working order and shall be adjusted within one-fourth inch of the wheel periphery at all times.

WAC 296-62-11017 (Cont.)

(c) Swing-frame grinders shall be provided with exhaust booths as indicated in Figure 5. (See Fig. 5 following this section.)

(d) Portable grinding operations, whenever the nature of the work permits, shall be conducted within a partial enclosure. The opening in the enclosure shall be no larger than is actually required in the operation and an average face air velocity of not less than 200 feet per minute shall be maintained.

(e) Hoods for polishing and buffing and scratch-brush wheels shall be constructed to conform as closely to Figure 6 as the nature of the work will permit. (See Fig. 6 following this section.)

(f) Cradle grinding and polishing operations shall be performed within a partial enclosure similar to Figure 7. (See Fig. 7 following this section.) The operator shall be positioned outside the working face of the opening of the enclosure. The face opening of the enclosure should not be any greater in area than that actually required for the performance of the operation and the average air velocity into the working face of the enclosure shall not be less than 150 feet per minute.

(g) Hoods for horizontal single-spindle disc grinders shall be constructed to conform as closely as possible to the hood shown in Figure 8. (See Fig. 8 following this section.) It is essential that there be a space between the back of the wheel and the hood, and a space around the periphery of the wheel of at least 1 inch in order to permit the suction to act around the wheel periphery. The opening on the side of the disc shall be no larger than is required for the grinding operation, but must never be less than twice the area of the branch outlet.

(h) Horizontal double-spindle disc grinders shall have a hood encircling the wheels and grinding chamber similar to that illustrated in Figure 9. (See Fig. 9 following this section.) The openings for passing the work into the grinding chamber should be kept as small as possible, but must never be less than twice the area of the branch outlets.

(i) Vertical-spindle disc grinders shall be encircled with a hood so constructed that the heavy dust is drawn off a surface of the disc and the lighter dust exhausted through a continuous slot at the top of the hood as shown in Figure 3. (See Fig. 3 following this section.)

(j) Grinding and polishing belt hoods shall be constructed as close to the operation as possible. The hood should extend almost to the belts, and 1-inch wide openings should be provided on either side. Figure 10 shows a typical hood for a belt operation. (See Fig. 10 following this section.)

(6) **Scope.** This paragraph, prescribes the use of exhaust hood enclosures and systems in removing dust, dirt, fumes, and gases generated through the grinding, polishing, or buffing of ferrous and nonferrous metals.

WAC 296-62-11017 (Cont.)

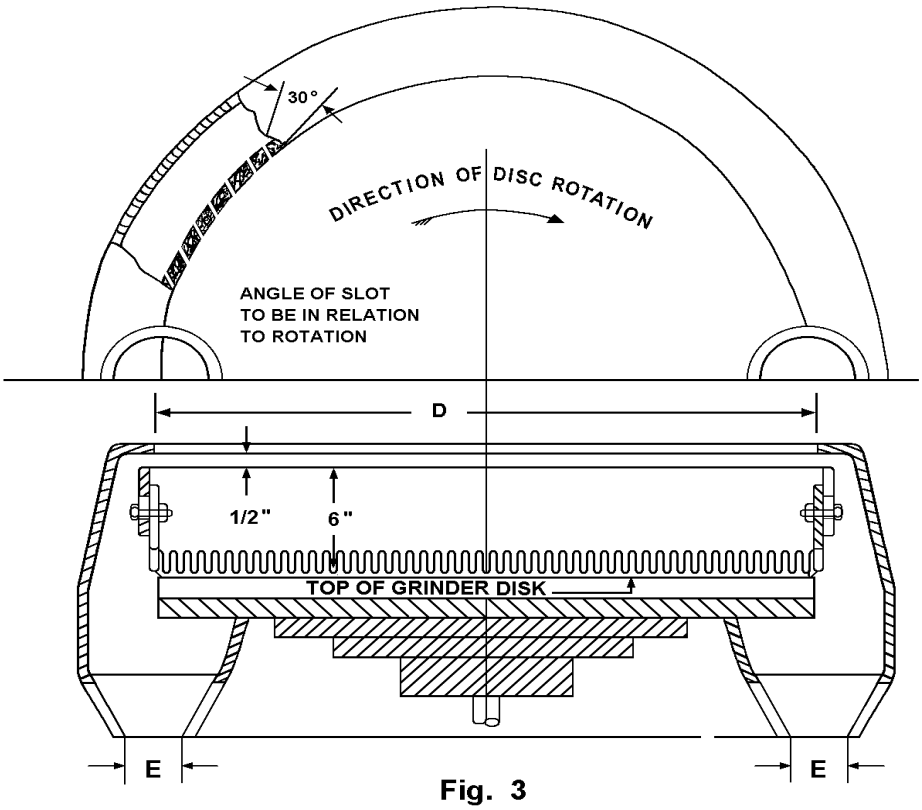

Fig. 3

Vertical Spindle Disc Grinder Exhaust Hood and Branch Pipe Connections

Dia D. Inches		Exhaust E		Volume Exhausted	
		No.		at 4,500 ft/min	
Min.	Max	Pipes	Dia	ft^3/min	Note
	20	1	4 1/2	500	When one-half or more of
Over 20	30	2	4	780	the disc can be hooded, use
Over 30	72	2	6	1,770	exhaust ducts as shown at
Over 53	72	2	8	3,140	the left.
	20	2	4	780	When no hood can be used
Over 20	30	2	5 1/2	1,480	over disc, use exhaust
Over 30	53	4	6	3,530	ducts as shown at left.
Over 53	72	5	7	6,010	

Entry loss = 1.0 slot velocity pressure + 0.5 branch velocity pressure
Minimum slot velocity = 2,000 ft/min - 1/2-inch slot width

WAC 296-62-11017 (Cont.)

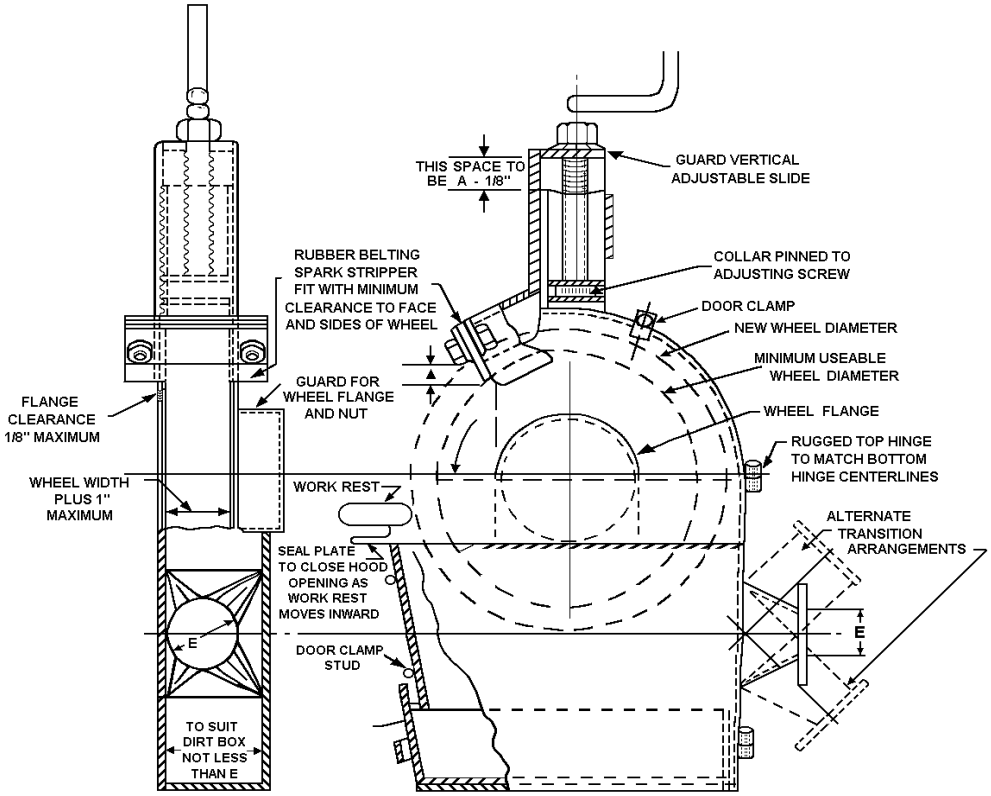

Fig. 4
Standard Grinder Hood

TABLE 10
HORIZONTAL SINGLE-SPINDLE DISC GRINDER

Wheel dimension inches Diameter Min = d	Max = D	Width Max	Exhaust Outlet, Inches E	Volume of Air at 4,500 ft/min
	9	1 1/2	3	220
Over 9	16	2	4	390
Over 16	19	3	4 1/2	500
Over 19	24	4	5	610
Over 24	30	5	6	880
Over 30	36	6	7	1.200

Entry loss = 0.45 velocity pressure for tapered takeoff
0.65 velocity pressure for straight takeoff

WAC 296-62-11017 (Cont.)

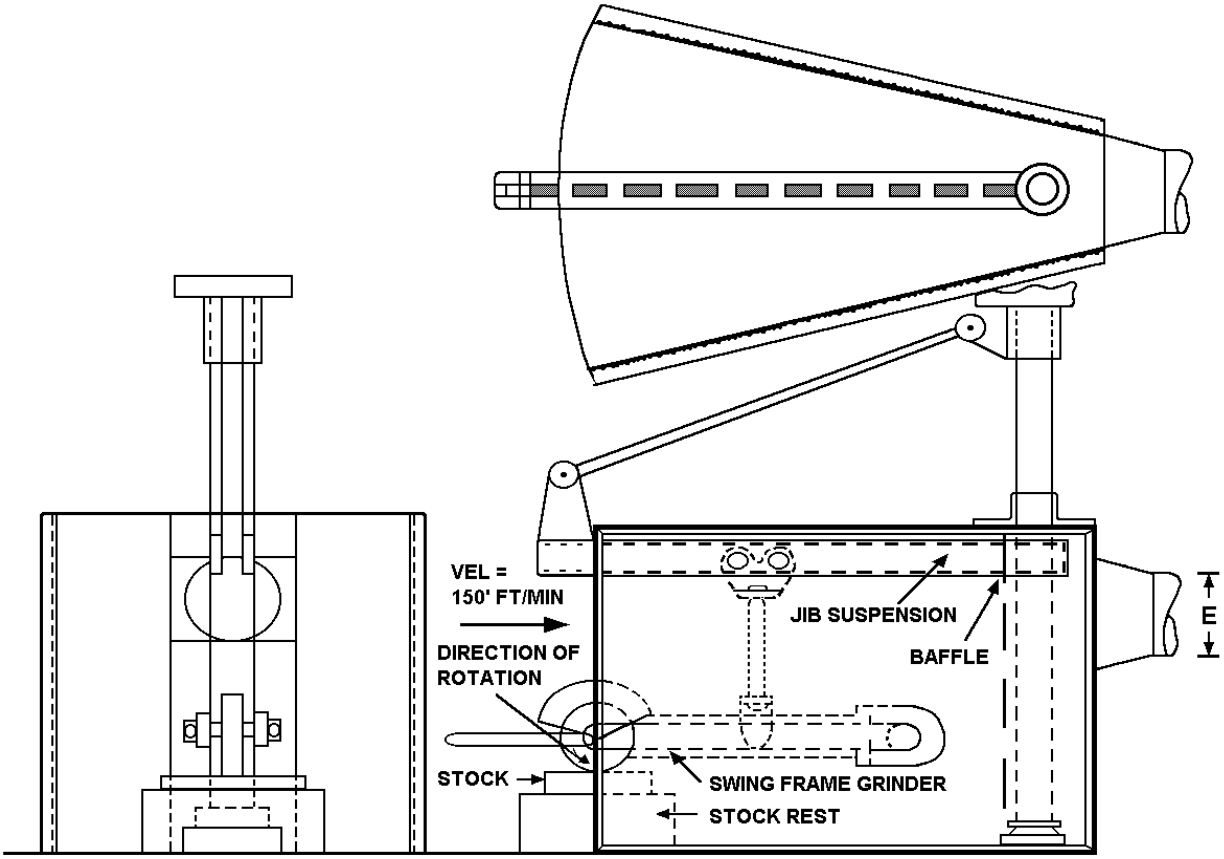

Fig. 5
A Method of Applying an Exhaust Enclosure to Swing-Frame Grinders
NOTE: Baffle to reduce front opening as much as possible

WAC 296-62-11017 (Cont.)

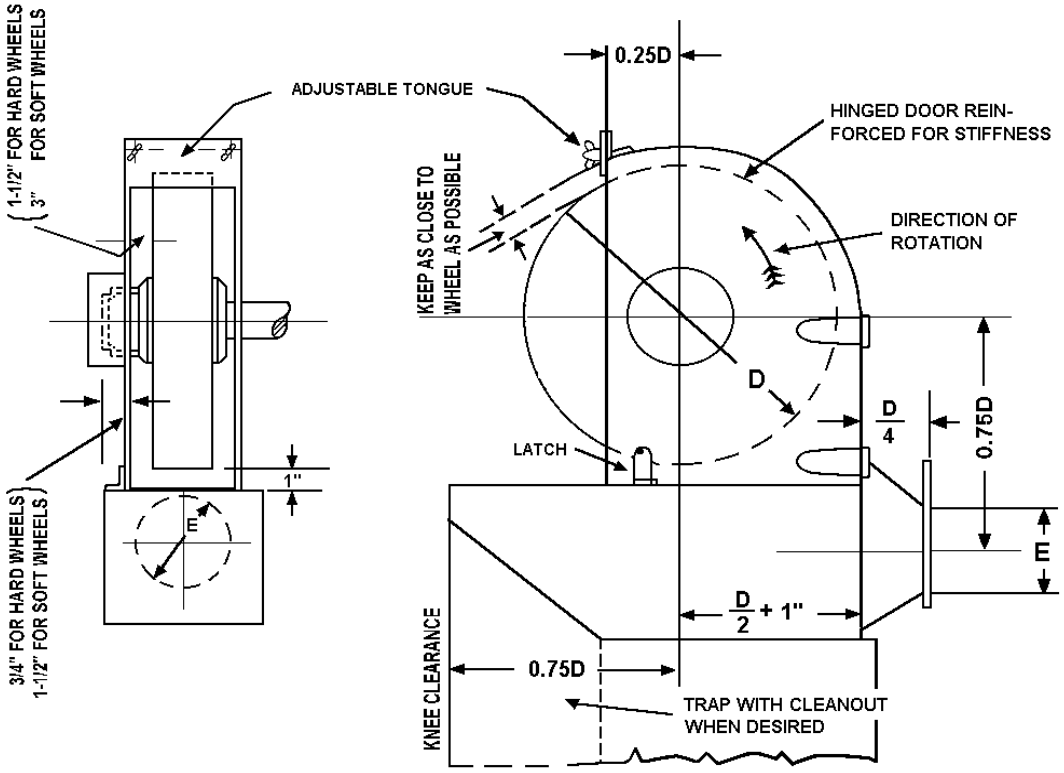

Fig. 6
Standard Buffing and Polishing Hood

Wheel dimension inches Diameter Min = d	Max = D	Width Max	Exhaust Outlet, Inches E	Volume of Air at 4,500 ft/min
	9	2	3 1/2	300
Over 9	16	3	4	500
Over 16	19	4	5	610
Over 19	24	5	5 1/2	740
Over 24	30	6	6 1/2	1,040
Over 30	36	6	7	1,200

Entry loss = 0.45 velocity pressure for tapered takeoff
0.65 velocity pressure for straight takeoff

WAC 296-62-11017 (Cont.)

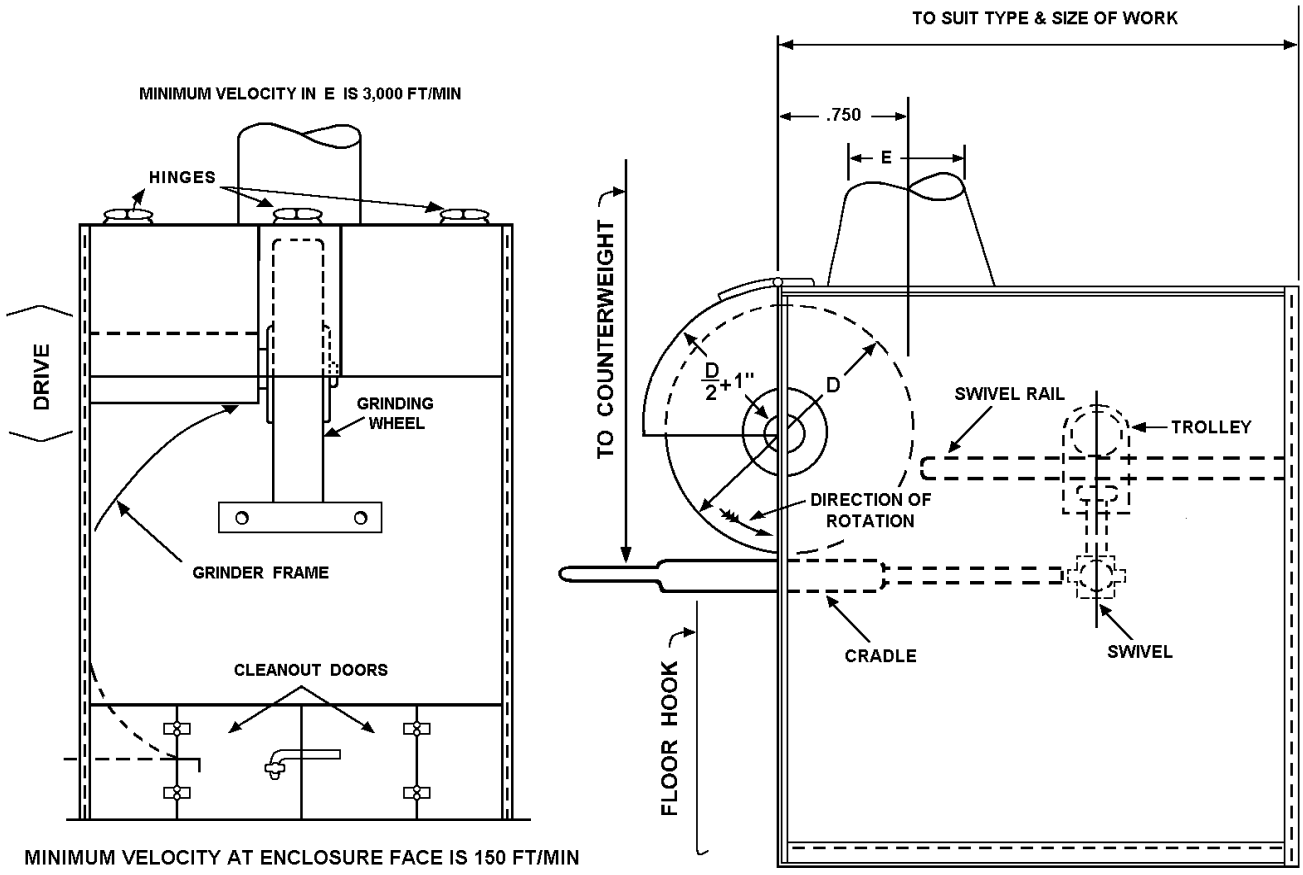

Fig. 7
Cradle Polishing or Grinding Enclosure
Entry loss = 0.45 velocity pressure for tapered takeoff

WAC 296-62-11017 (Cont.)

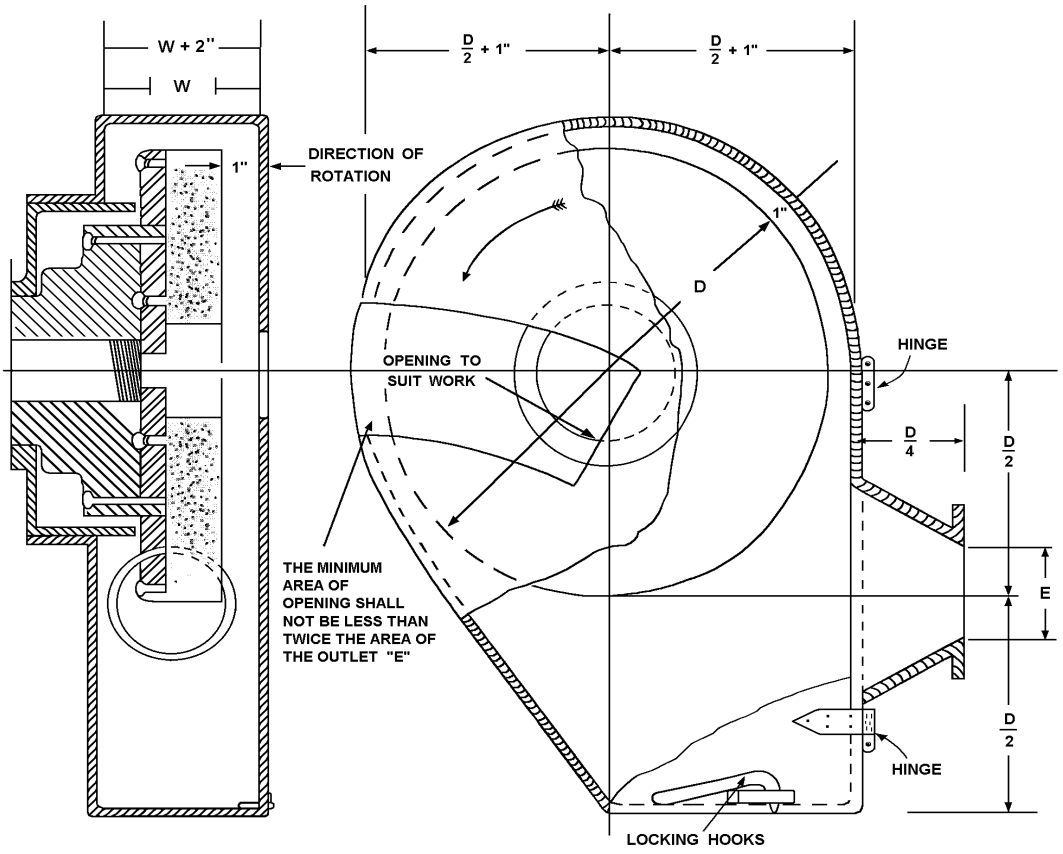

Fig. 8
Horizontal Single-Spindle Disc Grinder
Exhaust Hood and Branch Pipe Connection

Dia. D. Inches		Exhaust E	Volume of air at
Min	Max	Dia. Inches	4,500 ft/min
	12	3	220
Over 12	19	4	390
Over 19	30	5	610
Over 30	36	6	880

Note: *If grinding wheels are used for disc grinding purposes, hoods must conform to structural strength and materials as described in 9.1.*
Entry loss = 0.45 velocity pressure for tapered takeoff

WAC 296-62-11017 (Cont.)

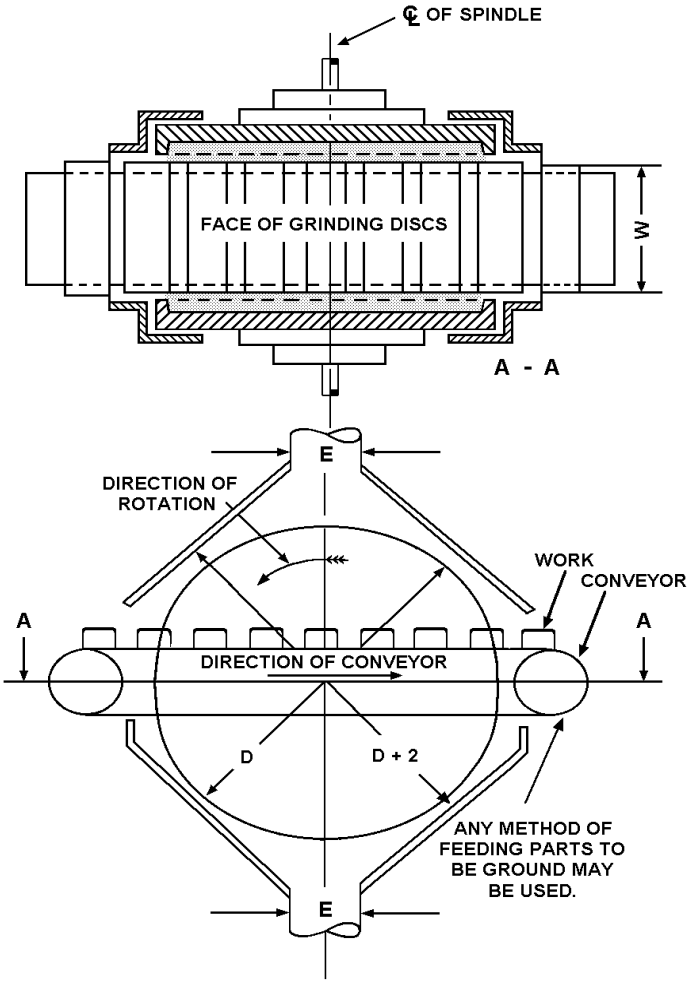

Fig. 9
Horizontal Double-Spindle Disc Grinder
Exhaust Hood and Branch Pipe Connection

Dia D. Inches		Exhaust E No.		Volume Exhausted at 4,500 ft/min.	
Min.	Max	Pipes	Dia	ft^3/min	Note
	19	1	5	610	When width "W"
Over 19	25	1	6	880	permits, exhaust
Over 25	30	1	7	1,200	ducts should be near
Over 30	53	2	6	1,770	heaviest grinding as
Over 72	72	4	8	6,280	possible.

Entry loss = 0.45 velocity pressure for tapered takeoff

WAC 296-62-11017 (Cont.)

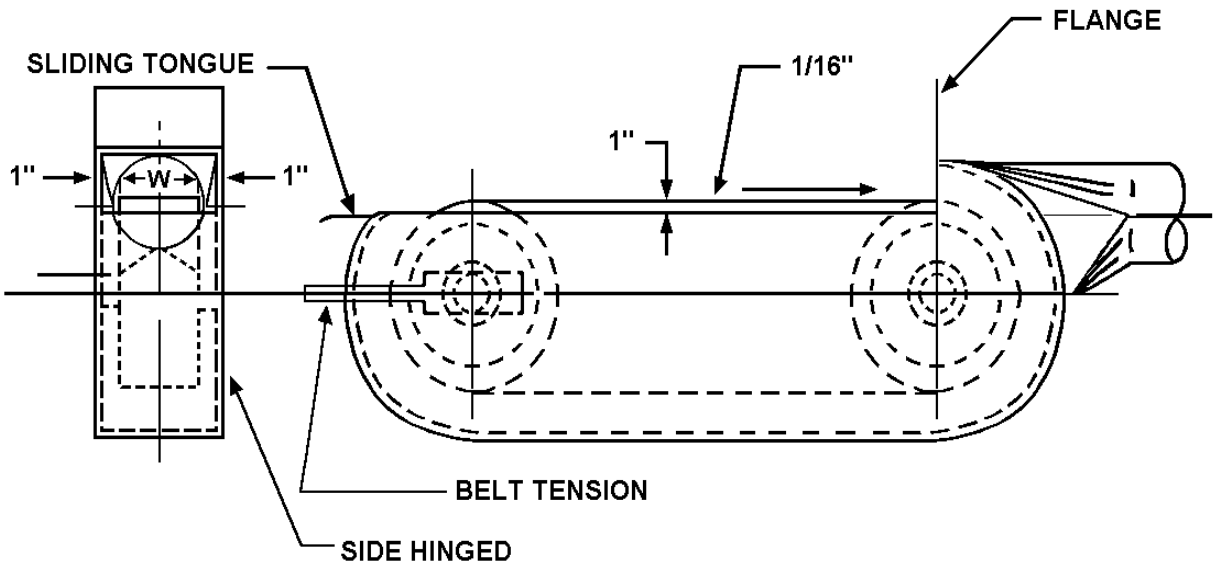

Figure 10
A Typical Hood for a Belt Operation

Belt Width w. Inches	Exhaust Volume ft^3/min.
Up to 3	220
3 to 5	300
5 to 7	390
7 to 9	500
9 to 11	610
11 to 13	740

Minimum duct velocity = 4.500 ft./min. branch.
3.500 ft./min. main.

Entry loss = 0.45 velocity pressure for tapered takeoff
0.65 velocity pressure for straight takeoff

[Order 73-3, 296-62-11017 and diagrams, filed 5/7/73.]

WAC 296-62-11019 Spray-finishing operations.

(1) **Definitions.**

(a) **"Spray-finishing operations"** means employment of methods wherein organic or inorganic materials are utilized in dispersed form from deposit on surfaces to be coated, treated or cleaned. Such methods of deposit may involve either automatic, manual, or electrostatic deposition but do not include metal spraying or metallizing, dipping, flow coating, roller coating, tumbling, centrifuging, or spray washing and degreasing as conducted in self-contained washing and degreasing machines or systems.

(b) **"Spray booth"** spray booths are defined and described in WAC 296-24-370 through 296-24-37007. (See sections 103, 104, and 105 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969.)

(c) **"Spray room"** means a room in which spray-finishing operations not conducted in a spray booth are performed separately from other areas.

WAC 296-62-11019 (Cont.)

(d) **"Minimum maintained velocity"** means the velocity of air movement which must be maintained in order to meet minimum specified requirements for health and safety.

(2) **Location and application.** Spray booths or spray rooms are to be used to enclose or confine all operations. Spray-finishing operations shall be located as provided in sections 201 through 206 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969.

(3) **Design and construction of spray booths.**

(a) Spray booths shall be designed and constructed in accordance with WAC 296-24-370 through 296-24-37007 (see sections 301-304 and 306-310 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969), for general construction specifications.

Note: For a more detailed discussion of fundamentals relating to this subject, see ANSI Z9.2-1960.

(i) Lights, motors, electrical equipment and other sources of ignition shall conform to the requirements of WAC 296-24-370. (See section 310 and chapter 4 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969.)

(ii) In no case shall combustible material be used in the construction of a spray booth and supply or exhaust duct connected to it.

(b) Unobstructed walkways shall not be less than 6 1/2 feet high and shall be maintained clear of obstruction from any work location in the booth to a booth exit or open booth front. In booths where the open front is the only exit, such exits shall be not less than 3 feet wide. In booths having multiple exits, such exits shall not be less than 2 feet wide, provided that the maximum distance from the work location to the exit is 25 feet or less. Where booth exits are provided with doors, such doors shall open outward from the booth.

(c) Baffles, distribution plates, and dry-type overspray collectors shall conform to the requirements of WAC 296-24-370. (See sections 304 and 305 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969.)

(i) Overspray filters shall be installed and maintained in accordance with the requirements of WAC 296-24-370, (See section 305 of the Standard for Spray Finishing Using Flammable and Combustible Materials, NFPA No. 33-1969), and shall only be in a location easily accessible for inspection, cleaning, or replacement.

(ii) Where effective means, independent of the overspray filters are installed which will result in design air distribution across the booth cross section, it is permissible to operate the booth without the filters in place.

(d)(i) For wet or water-wash spray booths, the water-chamber enclosure, within which intimate contact of contaminated air and cleaning water or other cleaning medium is maintained, if made of steel, shall be 18 gauge or heavier and adequately protected against corrosion.

(ii) Chambers may include scrubber spray nozzles, headers, troughs, or other devices. Chambers shall be provided with adequate means for creating and maintaining scrubbing action for removal of particulate matter from the exhaust air stream.

(e) Collecting tanks shall be of welded steel construction or other suitable noncombustible material. If pits are used as collecting tanks, they shall be concrete, masonry, or other material having similar properties.

WAC 296-62-11019 (Cont.)

(i) Tanks shall be provided with weirs, skimmer plates, or screens to prevent sludge and floating paint from entering the pump suction box. Means for automatically maintaining the proper water level shall also be provided. Fresh water inlets shall not be submerged. They shall terminate at least one pipe diameter above the safety overflow level of the tank.

(ii) Tanks shall be so constructed as to discourage accumulation of hazardous deposits.

(f) Pump manifolds, risers, and headers shall be adequately sized to insure sufficient water flow to provide efficient operation of the water chamber.

(4) **Design and construction of spray rooms.**

(a) Spray rooms, including floors, shall be constructed of masonry, concrete, or other noncombustible material.

(b) Spray rooms shall have noncombustible fire doors and shutters.

(c) Spray rooms shall be adequately ventilated so that the atmosphere in the breathing zone of the operator shall be maintained in accordance with the requirements of (6)(b) of this section.

(d) Spray rooms used for production spray-finishing operations shall conform to the requirements of spray booths.

(5) **Ventilation.**

(a) Ventilation shall be provided in accordance with provisions of WAC 296-24-370, (See chapter 5 of the Standard for Spray Finishing Using Flammable or Combustible Materials, NFPA No. 33-1969), and in accordance with the following:

(i) Where a fan plenum is used to equalize or control the distribution of exhaust air movement through the booth, it shall be of sufficient strength or rigidity to withstand the differential air pressure or other superficially imposed loads for which the equipment is designed and also to facilitate cleaning. Construction specifications shall be at least equivalent to those of (5)(c) of this section.

(ii) All fan ratings shall be in accordance with Air Moving and Conditioning Association Standard Test Code for Testing Air Moving Devices, Bulletin 210, April 1962.

(b) Inlet or supply ductwork used to transport makeup air to spray booths or surrounding areas shall be constructed of noncombustible materials.

(i) If negative pressure exists within inlet ductwork, all seams and joints shall be sealed if there is a possibility of infiltration of harmful quantities of noxious gases, fumes, or mists from areas through which ductwork passes.

(ii) Inlet ductwork shall be sized in accordance with volume flow requirements and provide design air requirements at the spray booth.

(iii) Inlet ductwork shall be so supported throughout its length to sustain at least its own weight plus any negative pressure which is exerted upon it under normal operating conditions.

(c) Ducts shall be so constructed as to provide structural strength and stability at least equivalent to sheet steel of not less than the following thickness:

WAC 296-62-11019 (Cont.)

DIAMETER OR GREATER DIMENSION

	(U.S. gauge)
Up to 8 inches inclusive	No. 24
Over 8 inches to 18 inches inclusive	No. 22
Over 18 inches to 30 inches inclusive	No. 20
Over 30 inches	No. 18

(i) Exhaust ductwork shall be adequately supported throughout its length to sustain its weight plus any normal accumulation in interior during normal operating conditions and any negative pressure exerted upon it.

(ii) Exhaust ductwork shall be sized in accordance with good design practice which shall include consideration of fan capacity, length of duct, number of turns and elbows, variation in size, volume, and character of materials being exhausted. See American National Standard Z9.2-1960 for further details and explanation concerning elements of design.

(iii) Longitudinal joints in sheet steel ductwork shall be either lock-seamed, riveted, or welded. For other than steel construction, equivalent securing of joints shall be provided.

(iv) Circumferential joints in ductwork shall be substantially fastened together and lapped in the direction of airflow. At least every fourth joint shall be provided with connecting flanges, bolted together or of equivalent fastening security.

(v) Inspection or clean-out doors shall be provided for every 9 to 12 feet of running length for ducts up to 12 inches in diameter, but the distance between clean-out doors may be greater for larger pipes. (See 8.3.21 of American National Standard Z9.1-1960.) A clean-out door or doors shall be provided for servicing the fan, and where necessary, a drain shall be provided.

(vi) Where ductwork passes through a combustible roof or wall, the roof or wall shall be protected at the point of penetration by open space or fire-resistive material between the duct and the roof or wall. When ducts pass through fire-walls, they shall be provided with automatic fire dampers on both sides of the wall, except that three-eighth-inch steel plates may be used in lieu of automatic fire dampers for ducts not exceeding 18 inches in diameter.

(vii) Ductwork used for ventilating any process covered in this standard shall not be connected to ducts ventilating any other process or any chimney or flue used for conveying any products of combustion.

(6) **Velocity and air flow requirements.**

(a) Except where a spray booth has an adequate air replacement system, the velocity of air into all openings of a spray booth shall be not less than that specified in Table 14 for the operating conditions specified. An adequate air replacement system is one which introduces replacement air upstream or above the object being sprayed and is so designed that the velocity of air in the booth cross section is not less than that specified in Table 14 when measured upstream or above the object being sprayed.

WAC 296-62-11019 (Cont.)

Table 14
Minimum Maintained Velocities into Spray Booths

Operating Airflow conditions For object Completely inside booth	Crossdraft f.p.m.	Airflow Velocities f.p.m. Design	Range
Electrostatic and automatic airless operation contained in booth without operator.	Negligible	50 large booth 100 small booth	50-75 75-125
Air-operated guns, manual or automatic	Up to 50	100 large booth 150 small booth	75-125 125-175
Air-operated guns, manual or automatic	Up to 100	150 large booth 200 small booth	125-175 150-250

Notes:

(1) Attention is invited to the fact that the effectiveness of the spray booth is dependent upon the relationship of the depth of the booth to its height and width.

(2) Crossdrafts can be eliminated through proper design and such design should be sought. Crossdrafts in excess of 100 fpm (feet per minute) should not be permitted.

(3) Excessive air pressures result in loss of both efficiency and material waste in addition to creating a backlash that may carry overspray and fumes into adjacent work areas.

(4) Booths should be designed with velocity shown in the column headed "Design." However, booths operating with velocities shown in the column headed "Range" are in compliance with this standard.

(b) In addition to the requirements in (6)(a) of this section the total air volume exhausted through a spray booth shall be such as to dilute solvent vapor to at least 25 percent of the lower explosive limit of the solvent being sprayed. An example of the method of calculating this volume is given below.

Example: *To determine the lower explosive limits of the most common solvents used in spray finishing, see Table 15. Column 1 gives the number of cubic feet of vapor per gallon of solvent and column 2 gives the lower explosive limit (LEL) in percentage by volume of air. Note that the quantity of solvent will be diminished by the quantity of solids and nonflammable contained in the finish.*

To determine the volume of air in cubic feet necessary to dilute the vapor from 1 gallon of solvent to 25 percent of the lower explosive limit, apply the following formula:

$$\text{Dilution volume required per gallon of solvent} = \frac{4\,(100-\text{LEL})\,(\text{cubic feet of vapor per gallon})}{\text{LEL}}$$

Using toluene as the solvent.

(1) LEL of toluene from Table 15, column 2, is 1.4 percent.

(2) Cubic feet of vapor per gallon from Table 15, column 1, is 30.4 cubic feet per gallon.

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(3) Dilution volume required =

$$\frac{4\ (100\text{-}1.4)\ 30.4}{1.4} = 8{,}564 \text{ cubic feet.}$$

(4) To convert to cubic feet per minute of required ventilation, multiply the dilution volume required per gallon of solvent by the number of gallons of solvent evaporated per minute.

TABLE 15
LOWER EXPLOSIVE LIMIT OF SOME COMMONLY USED SOLVENTS

Solvent	Cubic feet of vapor per gallon of liquid at 70°F.	Lower explosive limit in percent by volume of air at 70°F.
	Column 1	Column 2
Acetone	44.0	2.6
Amyl Acetate (iso)	21.6	1.0*
Amyl Alcohol (n)	29.6	1.2
Amyl Alcohol (iso)	29.6	1.2
Benzene	36.8	1.4*
Butyl Acetate (n)	24.8	1.7
Butyl Alcohol (n)	35.2	1.4
Butyl Cellosolve	24.8	1.1
Cellosolve	33.6	1.8
Cellosolve Acetate	23.2	1.7
Cyclohexanone	31.2	1.1*
1,1 Dichloroethylene	42.4	5.6
1,2 Dichloroethylene	42.4	9.7
Ethyl Acetate	32.8	2.5
Ethyl Alcohol	55.2	4.3
Ethyl Lactate	28.0	1.5*
Methyl Acetate	40.0	3.1
Methyl Alcohol	80.8	7.3
Methyl Cellosolve	40.8	2.5
Methyl Ethyl Ketone	36.0	1.8
Methyl n-Propyl Ketone	30.4	1.5
Naphtha (VM&P) (76° Naphtha) Naphtha (100° Flash)	22.4	0.9
Safety solvent-Stoddard Solvent	23.2	1.1
Propyl Acetate(n)	27.2	2.0
Propyl Acetate (iso)	28.0	1.8
Propyl Alcohol (n)	44.8	2.1
Propyl Alcohol (iso)	44.0	2.0
Toluene	30.4	1.4
Turpentine	20.8	0.8
Xylene (o)	26.4	1.0

* At 212°F

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(c)(i) When an operator is in a booth downstream of the object being sprayed, an air-supplied respirator or other type of respirator certified by NIOSH under 42 CFR part 84 for the material being sprayed should be used by the operator.

(ii) Where downdraft booths are provided with doors, such doors shall be closed when spray painting.

(7) **Make-up air.**

(a) Clean fresh air, free of contamination from adjacent industrial exhaust systems, chimneys, stacks, or vents, shall be supplied to a spray booth or room in quantities equal to the volume of air exhausted through the spray booth.

(b) Where a spray booth or room receives make-up air through self-closing doors, dampers, or louvers, they shall be fully open at all times when the booth or room is in use for spraying. The velocity of air through such doors, dampers, or louvers shall not exceed 200 feet per minute. If the fan characteristics are such that the required air flow through the booth will be provided, higher velocities through the doors, dampers, or louvers may be used.

(c)(i) Where the air supply to a spray booth or room is filtered, the fan static pressure shall be calculated on the assumption that the filters are dirty to the extent that they require cleaning or replacement.

(ii) The rating of filters shall be governed by test data supplied by the manufacturer of the filter. A pressure gauge shall be installed to show the pressure drop across the filters. This gauge shall be marked to show the pressure drop at which the filters require cleaning or replacement. Filters shall be replaced or cleaned whenever the pressure drop across them becomes excessive or whenever the air flow through the face of the booth falls below that specified in Table 14.

(d)(i) Means of heating make-up air to any spray booth or room, before or at the time spraying is normally performed, shall be provided in all places where the outdoor temperature may be expected to remain below 55° F. for appreciable periods of time during the operation of the booth except where adequate and safe means of radiant heating for all operating personnel affected is provided. The replacement air during the heating seasons shall be maintained at not less than 65° F. at the point of entry into the spray booth or spray room. When otherwise unheated make-up air would be at a temperature of more than 10° F. below room temperature, its temperature shall be regulated as provided in section 3.6 of ANSI Z9.2-1960.

(ii) As an alternative to an air replacement system complying with the preceding section, general heating of the building in which the spray room or booth is located may be employed provided that all occupied parts of the building are maintained at not less than 65° F. when the exhaust system is in operation or the general heating system supplemented by other sources of heat may be employed to meet this requirement.

(iii) No means of heating make-up air shall be located in a spray booth.

(iv) Where make-up air is heated by coal or oil, the products of combustion shall not be allowed to mix with the make-up air, and the products of combustion shall be conducted outside the building through a flue terminating at a point remote from all points where make-up air enters the building.

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(v) Where make-up air is heated by gas, and the products of combustion are not mixed with the make-up air but are conducted through an independent flue to a point outside the building remote from all points where make-up air enters the building, it is not necessary to comply with (7)(d)(vi) of this section.

(vi) Where make-up air to any manually operated spray booth or room is heated by gas and the products of combustion are allowed to mix with the supply air, the following precautions must be taken:

(A) The gas must have a distinctive and strong enough odor to warn workmen in a spray booth or room of its presence if in an unburned state in the make-up air.

(B) The maximum rate of gas supply to the make-up air heater burners must not exceed that which would yield in excess of 200 p.p.m. (parts per million) of carbon monoxide or 2,000 p.p.m. of total combustible gases in the mixture if the unburned gas upon the occurrence of flame failure were mixed with all of the make-up air supplied.

(C) A fan must be provided to deliver the mixture of heated air and products of combustion from the plenum chamber housing the gas burners to the spray booth or room.

(8) **Scope.** Spray booths or spray rooms are to be used to enclose or confine all spray finishing operations covered by this paragraph. This paragraph does not apply to the spraying of the exteriors of buildings, fixed tanks, or similar structures, nor to small portable spraying apparatus not used repeatedly in the same location.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-11019, filed 05/04/99, effective 09/01/99.] Statutory Authority: RCW 49.17.040, 49.17.050, and 49.17.240. 81-16-015 (Order 81-20), 296-62-11019, filed 7/27/81; Order 73-3, 296-62-11019, filed 5/7/73.]

WAC 296-62-11021 Open surface tanks.

(1) **General.**

(a) This section applies to all operations involving the immersion of materials in liquids, or in the vapors of such liquids, for the purpose of cleaning or altering the surface or adding to or imparting a finish thereto or changing the character of the materials, and their subsequent removal from the liquid or vapor, draining, and drying. These operations include washing, electroplating, anodizing, pickling, quenching, dyeing, dipping, tanning, dressing, bleaching, degreasing, alkaline cleaning, stripping, rinsing, digesting, and other similar operations.

(b) Except where specific construction specifications are prescribed in this section, hoods, ducts, elbows, fans, blowers, and all other exhaust system parts, components, and supports thereof shall be so constructed as to meet conditions of service and to facilitate maintenance and shall conform in construction to the specifications contained in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(2) **Classification of open-surface tank operations.**

(a) Open-surface tank operations shall be classified into 16 classes, numbered A-1 to D-4, inclusive.

(b) Determination of class. Class is determined by two factors, hazard potential designated by a letter from A to D, inclusive, and rate of gas, vapor, or mist evolution designated by a number from 1 to 4, inclusive (for example, B.3).

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(c) Hazard potential is an index, on a scale of from A to D, inclusive, of the severity of the hazard associated with the substance contained in the tank because of the toxic, flammable, or explosive nature of the vapor, gas, or mist produced therefrom. The toxic hazard is determined from the concentration, measured in parts by volume of a gas or vapor, per million parts by volume of contaminated air (ppm), or in milligrams of mist per cubic meter of air (mg/m^3), below which ill effects are unlikely to occur to the exposed worker. The concentrations shall be those in WAC 296-62-075 through 296-62-07515.

(d) The relative fire or explosion hazard is measured in degrees Fahrenheit in terms of the closed-cup flash point of the substance in the tank. Detailed information on the prevention of fire hazards in dip tanks may be found in Dip Tanks Containing Flammable or Combustible Liquids, NFPA No. 34-1966, National Fire Protection Association. Where the tank contains a mixture of liquids, other than organic solvents, whose effects are additive, the hygienic standard of the most toxic component (for example, the one having the lowest ppm or mg/m^3) shall be used, except where such substance constitutes an insignificantly small fraction of the mixture. For mixtures of organic solvents, their combined effect, rather than that of either individually, shall determine the hazard potential. In the absence of information to the contrary, the effects shall be considered as additive. If the sum of the ratios of the airborne concentration of that contaminant exceeds unity, the toxic concentration shall be considered to have been exceeded. (See Note A of (2)(e) of this section.)

(e) Hazard potential shall be determined from Table 16, with the value indicating greater hazard being used. When the hazardous material may be either a vapor with a permissible exposure limit in ppm or a mist with a TLV in mg/m^3, the TLV indicating the greater hazard shall be used (for example, A takes precedence over B or C; B over C; C over D).

Note A:

$$\frac{c_1}{PEL} + \frac{c_2}{PEL} + \frac{c_3}{PEL} + \ldots + \frac{c_N}{PEL} > 1$$

where:

c = Concentration measured at the operation in ppm.

TABLE 16
DETERMINATION OF HAZARD POTENTIAL

		Toxicity Group	
Hazard Potential	**Gas or Vapor (ppm)**	**Mist (mg/m^3)**	**Flash Point (in degrees F.)**
A	0 - 10	0 - 0.1	…
B	11 - 100	0.11 - 1.0	Under 100
C	101 - 500	1.1 - 10	100-200
D	Over 500	Over 10	Over 200

(f) Rate of gas, vapor, or mist evolution is a numerical index, on a scale of from 1 to 4, inclusive, both of the relative capacity of the tank to produce gas, vapor, or mist and of the relative energy with which it is projected or carried upwards from the tank. Rate is evaluated in terms of;

(i) The temperature of the liquid in the tank in degrees Fahrenheit;

(ii) The number of degrees Fahrenheit that this temperature is below the boiling point of the liquid in degrees Fahrenheit;

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(iii) The relative evaporation of the liquid in still air at room temperature in an arbitrary scale--fast, medium, slow, or nil; and

(iv) The extent that the tank gases or produces mist in an arbitrary scale--high, medium, low, and nil. (See Table 17, Note 2.) Gassing depends upon electrochemical or mechanical processes, the effects of which have to be individually evaluated for each installation (see Table 17, Note 3).

(g) Rate of evolution shall be determined from Table 17. When evaporation and gassing yield different rates, the lowest numerical value shall be used.

TABLE 17
DETERMINATION OF RATE OF GAS, VAPOR, OR MIST EVOLUTION*

Rate	Liquid Temperature, °F	Degrees below boiling point	Evaporation**	Relative Gassing***
1	Over 200	0 - 20	Fast	High
2	150 - 200	21 - 50	Medium	Medium
3	94 - 149	51 - 100	Slow	Low
4	Under 94	Over 100	Nil	Nil

Note In certain classes of equipment, specifically vapor degreasers, an internal condenser or vapor level thermostat is used to prevent the vapor from leaving the tank during normal operations. In such cases, rate of vapor evolution from the tank into the workroom is not dependent upon the factors listed in the table, but rather upon abnormalities of operating procedure, such as carry out of vapors from excessively fast action, dragout of liquid by entrainment in parts, contamination of solvent by water and other materials, or improper heat balance. When operating procedure is excellent, effective rate of evolution may be taken as 4. When operating procedures are average, the effective rate of evolution may be taken as 3. When operation is poor, a rate of 2 or 1 is indicated, depending upon observed conditions.*

*Note** Relative evaporation rate is determined according to the methods described by A. K. Doolittle in Industrial and Engineering Chemistry, vol. 27, p. 1169, (3) where time for 100-- percent evaporation is as follows: Fast: 0-3 hours; Medium: 3-12 hours; Slow: 12-50 hours; Nil: more than 50 hours.*

*Note*** Gassing means the formation by chemical or electrochemical action of minute bubbles of gas under the surface of the liquid in the tank and is generally limited to aqueous solutions.*

(3) **Ventilation.** Where ventilation is used to control potential exposures to workers as defined in (2)(c) of this section, it shall be adequate to reduce the concentration of the air contaminant to the degree that a hazard to the worker does not exist. Methods of ventilation are discussed in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960.

(4) **Control requirements.**

(a) Control velocities shall conform to Table 18 in all cases where the flow of air past the breathing or working zone of the operator and into the hoods is undisturbed by local environmental conditions, such as open windows, wall fans, unit heaters, or moving machinery.

(b) All tanks exhausted by means of hoods which;

(i) Project over the entire tank;

(ii) Are fixed in position in such a location that the head of the workman, in all his normal operating positions while working at the tank, is in front of all hood openings; and

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(iii) Are completely enclosed on at least two sides, shall be considered to be exhausted through an enclosing hood.

(iv) The quantity of air in cubic feet per minute necessary to be exhausted through an enclosing hood shall be not less than the product of the control velocity times the net area of all openings in the enclosure through which air can flow into the hood.

TABLE 18
CONTROL VELOCITIES IN FEET PER MINUTE (F.P.M.) FOR UNDISTURBED LOCATIONS

Class (See subparagraph (2) and Table 16 and 17))	Enclosing hood (See subparagraph (4)(ii))		Lateral exhaust* (See subparagraph (4)(iii))	Canopy Hood** (See subparagraph (4)(iv))	
	One Open side	Two open sides		Three Open sides	Four open sides
A-1 and A-2	150	150	150	Do not use	Do not use
A-3 (Note**), B-1, B-2, And C-1,	75	100	100	127	175
B-3, C-2, and D-1 (Note***)	65	90	75	100	150
A-4 (Note**), C-3 and D-2 (Note***)	50	75	50	75	125
B-4, C-4, D-3 (Note***), and D-4	General room ventilation required.				

*See Table 19 for computation of ventilation rate.
**Do not use canopy hood for Hazard Potential A processes.
***Where complete control of hot water is desired, design as next highest class.

(c) All tanks exhausted by means of hoods which do not project over the entire tank, and in which the direction of air movement into the hood or hoods is substantially horizontal, shall be considered to be laterally exhausted. The quantity of air in cubic feet per minute necessary to be laterally exhausted per square foot of tank area in order to maintain the required control velocity shall be determined from Table 19 for all variations in ratio of tank width (W) to tank length (L). The total quantity of air in cubic feet per minute required to be exhausted per tank shall be not less than the product of the area of tank surface times the cubic feet per minute per square foot of tank area, determined from Table 19.

(i) For lateral exhaust hoods over 42 inches wide, or where it is desirable to reduce the amount of air removed from the workroom, air supply slots or orifices shall be provided along the side or the center of the tank opposite from the exhaust slots. The design of such systems shall meet the following criteria:

(A) The supply air volume plus the entrained air shall not exceed 50 percent of the exhaust volume.

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(B) The velocity of the supply airstream as it reaches the effective control area of the exhaust slot shall be less than the effective velocity over the exhaust slot area.

(C) The vertical height of the receiving exhaust hood, including any baffle, shall not be less than one-quarter the width of the tank.

(D) The supply airstream shall not be allowed to impinge on obstructions between it and the exhaust slot in such a manner as to significantly interfere with the performance of the exhaust hood.

TABLE 19
MINIMUM VENTILATION RATE IN CUBIC FEET OF AIR PER MINUTE PER SQUARE FOOT OF TANK AREA FOR LATERAL EXHAUST

Required Minimum Control Velocity, f.p.m. (from Table)	**C.f.m. per sq. ft. to maintain required Minimum velocities at following ratios (tank width (W)/tank length (L))).*.***				
	0.0-0.09	0.1-0.24	0.25-0.49	0.5-0.99	1.0-2.0
Hood along one side or two parallel sides of tank when one hood is against a wall or baffle.**					
50	50	60	75	90	100
75	75	90	110	130	150
100	100	125	150	175	200
150	150	190	225	260	300
Also for a manifold along tank centerline.***					
50	75	90	100	110	125
75	110	130	150	170	190
100	150	175	200	225	250
150	225	260	300	340	375
Hood along one side or two parallel sides of free standing tank not against wall or baffle.					

*It is not practicable to ventilate across the long dimension of a tank whose ratio W/L exceeds 2.0. It is understandable to do so when W/L exceeds 1.0. For circular tanks with lateral exhaust along up the circumference use W/L = 1.0 for over one-half the circumference use W/L = 0.5.

**Baffle is a vertical plate the same length as the tank, and with the top of the plate as high as the tank is wide. If the exhaust hood is on the side of a tank against a building wall or close to it, it is perfectly baffled.

***Use W/L as tank width in computing when manifold is along centerline, or when hoods are used on two parallel sides of a tank.

Tank Width (W) means the effective width over which the hood must pull air to operate (for example, where the hood face is not back from the edge of the tank, this set back must be added in measuring tank width). The surface area of tanks can frequently be reduced and better control obtained (particularly on conveyorized systems) by using covers extending from the upper edges of the slots toward the center of the tank.

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(E) Since most failure of push-pull systems result from excessive supply air volumes and pressures, methods of measuring and adjusting the supply air shall be provided. When satisfactory control has been achieved, the adjustable features of the hood shall be fixed so that they will not be altered.

(d) All tanks exhausted by means of hoods which project over the entire tank, and which do not conform to the definition of enclosing hoods, shall be considered to be overhead canopy hoods. The quantity of air in cubic feet per minute necessary to be exhausted through a canopy hood shall be not less than the product of the control velocity times the net area of all openings between the bottom edges of the hood and the top edges of the tank.

(e) The rate of vapor evolution (including steam or products of combustion) from the process shall be estimated. If the rate of vapor evolution is equal to or greater than 10 percent of the calculated exhaust volume required, the exhaust volume shall be increased in equal amount.

(5) **Spray cleaning and degreasing.** Wherever spraying or other mechanical means are used to disperse a liquid above an open-surface tank, control must be provided for the airborne spray. Such operations shall be enclosed as completely as possible. The inward air velocity into the enclosure shall be sufficient to prevent the discharge of spray into the workroom. Mechanical baffles may be used to help prevent the discharge of spray. Spray painting operations are covered in WAC 296-62-11019.

(6) **Control means other than ventilation.** Tank covers, foams, beads, chips, or other materials floating on the tank surface so as to confine gases, mists, or vapors to the area under the cover or to the foam, bead, or chip layer; or surface tension depressive agents added to the liquid in the tank to minimize mist formation, or any combination thereof, may all be used as gas, mist, or vapor control means for open-surface tank operations, provided that they effectively reduce the concentrations of hazardous materials in the vicinity of the worker below the limits set in accordance with (2) of this section.

(7) **System design.**

(a) The equipment for exhausting air shall have sufficient capacity to produce the flow of air required in each of the hoods and openings of the system.

(b) The capacity required in (7)(a) of this section shall be obtained when the airflow producing equipment is operating against the following pressure losses, the sum of which is the static pressure:

(i) Entrance losses into the hood.

(ii) Resistance to airflow in branch pipe including bends and transformations.

(iii) Entrance loss into the main pipe.

(iv) Resistance to airflow in main pipe including bends and transformations.

(v) Resistance of mechanical equipment; that is, filters, washers, condensers, absorbers, etc., plus their entrance and exit losses.

(vi) Resistance in outlet duct and discharge stack.

(c) Two or more operations shall not be connected to the same exhaust system where either one or the combination of the substances removed may constitute a fire, explosion, or chemical reaction hazard in the duct system. Traps or other devices shall be provided to insure that condensate in ducts does not drain back into any tank.

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(d) The exhaust system, consisting of hoods, ducts, air mover, and discharge outlet shall be designed in accordance with American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960, or the manual, Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists. Airflow and pressure loss data provided by the manufacturer of any air cleaning device shall be included in the design calculations.

(8) **Operation.**

(a) The required airflow shall be maintained at all times during which gas, mist, or vapor is emitted from the tank, and at all times the tank, the draining, or the drying area is in operation or use. When the system is first installed, the airflow from each hood shall be measured by means of a pitot traverse in the exhaust duct and corrective action taken if the flow is less than that required. When the proper flow is obtained, the hood static pressure shall be measured and recorded. At intervals of not more than 3 months operation, or after a prolonged shutdown period, the hoods and duct system shall be inspected for evidence of corrosion or damage. In any case where the airflow is found to be less than required, it shall be increased to the required value. (Information on airflow and static pressure measurement and calculations may be found in American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2-1960, or in the manual, Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists.)

(b) The exhaust system shall discharge to the outer air in such a manner that the possibility of its effluent entering any building is at a minimum. Recirculation shall only be through a device for contaminant removal which will prevent the creation of a health hazard in the room or area to which the air is recirculated.

(c) A volume of outside air in the range of 90 percent to 110 percent of the exhaust volume shall be provided to each room having exhaust hoods. The outside air supply shall enter the workroom in such a manner as not to be detrimental to any exhaust hood. The airflow of the makeup air system shall be measured on installation. Periodically, thereafter, the airflow should be remeasured, and corrective action shall be taken when the airflow is below that required. The makeup air shall be uncontaminated.

(9) **Personal protection.**

(a) All employees working in and around open surface tank operations must be instructed as to the hazards of their respective jobs, and in the personal protection and first aid procedures applicable to these hazards.

(b) All persons required to work in such a manner that their feet may become wet shall be provided with rubber or other impervious boots or shoes, rubbers, or wooden-soled shoes sufficient to keep feet dry.

(c) All persons required to handle work wet with a liquid other than water shall be provided with gloves impervious to such a liquid and of a length sufficient to prevent entrance of liquid into the tops of the gloves. The interior of gloves shall be kept free from corrosive or irritating contaminants.

(d) All persons required to work in such a manner that their clothing may become wet shall be provided with such aprons, coats, jackets, sleeves, or other garments made of rubber, or of other materials impervious to liquids other than water, as are required to keep their clothing dry. Aprons shall extend well below the top of boots to prevent liquid splashing into the boots. Provision of dry, clean, cotton clothing along with rubber shoes or short boots and an apron

impervious to liquids other than water shall be considered a satisfactory substitute where small parts are cleaned, plated, or acid dipped in open tanks and rapid work is required.

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(e) Whenever there is a danger of splashing, for example, when additions are made manually to the tanks, or when acids and chemicals are removed from the tanks, the employees so engaged shall be required to wear either tight-fitting chemical goggles or an effective face shield. (See WAC 296-800-160.)

(f) When, during emergencies as described in (11)(e) of this section, employees must be in areas where concentrations of air contaminants are greater than the limit set by (2)(c) of this section, or oxygen concentrations are less than 19.5%, they must be required to wear respirators adequate to reduce their exposure to a level below these limits or that provide adequate oxygen. Such respirators must also be provided in marked, quickly accessible storage compartments built for the purpose, when there exists the possibility of accidental release of hazardous concentrations of air contaminants. Respirators must be certified by NIOSH under 42 CFR part 84 and used in accordance with the apppicable provisions of chapter 296-62 WAC, Part E.

(g) Near each tank containing a liquid which may burn, irritate, or otherwise be harmful to the skin if splashed upon the worker's body, there shall be a supply of clean cold water. The water pipe (carrying a pressure not exceeding 25 pounds) shall be provided with a quick opening valve and at least 48 inches of hose not smaller than three-fourths inch, so that no time may be lost in washing off liquids from the skin or clothing. Alternatively, deluge showers and eye flushes shall be provided in cases where harmful chemicals may be splashed on parts of the body.

(h) Operators with sores, burns, or other skin lesions requiring medical treatment shall not be allowed to work at their regular operations until so authorized by a physician. Any small skin abrasions, cuts, rash, or open sores which are found or reported shall be treated by a properly designated person so that chance of exposures to the chemicals are removed. Workers exposed to chromic acids shall have a periodic examination made of the nostrils and other parts of the body, to detect incipient ulceration.

(i) Sufficient washing facilities, including soap, individual towels, and hot water, shall be provided for all persons required to use or handle any liquids which may burn, irritate, or otherwise be harmful to the skin, on the basis of at least one basin (or its equivalent) with a hot water faucet for every 10 employees. (See WAC 296-800-230.)

(j) Locker space or equivalent clothing storage facilities shall be provided to prevent contamination of street clothing.

(k) First aid facilities specific to the hazards of the operations conducted shall be readily available.

(10) **Special precautions for cyanide.** Dikes or other arrangements shall be provided to prevent the possibility of intermixing of cyanide and acid in the event of tank rupture.

(11) **Inspection, maintenance, and installation.**

(a) Floors and platforms around tanks shall be prevented from becoming slippery both by original type of construction and by frequent flushing. They shall be firm, sound, and of the design and construction to minimize the possibility of tripping.

(b) Before cleaning the interior of any tank, the contents shall be drained off, and the cleanout doors shall be opened where provided. All pockets in tanks or pits, where it is possible for hazardous vapors to collect, shall be ventilated and cleared of such vapors.

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(c) Tanks which have been drained to permit employees to enter for the purposes of cleaning, inspection, or maintenance may contain atmospheres which are hazardous to life or health, through the presence of flammable or toxic air contaminants, or through the absence of sufficient oxygen. Before employees shall be permitted to enter any such tank, appropriate tests of the atmosphere shall be made to determine if the limits set by (2)(c) of this section are exceeded, or if the oxygen concentration is less than 19.5%.

(d) If the tests made in accordance with (11)(c) of this section indicate that the atmosphere in the tank is unsafe, before any employee is permitted to enter the tank, the tank shall be ventilated until the hazardous atmosphere is removed, and ventilation shall be continued so as to prevent the occurrence of a hazardous atmosphere as long as an employee is in the tank.

(e) If, in emergencies, such as rescue work, it is necessary to enter a tank which may contain a hazardous atmosphere, suitable respirators, such as self-contained breathing apparatus; hose mask with blower, if there is a possibility of oxygen deficiency; or a gas mask, selected and operated in accordance with (9)(f) of this section, shall be used. If a contaminant in the tank can cause dermatitis, or be absorbed through the skin, the employee entering the tank shall also wear protective clothing. At least one trained standby employee, with suitable respirator, shall be present in the nearest uncontaminated area. The standby employee must be able to communicate with the employee in the tank and be well able to haul him out of the tank with a lifeline if necessary.

(f) Maintenance work requiring welding or open flame, where toxic metal fumes such as cadmium, chromium, or lead may be evolved, shall be done only with sufficient local exhaust ventilation to prevent the creation of a health hazard, or be done with respirators selected and used in accordance with (9)(f) of this section. Welding, or the use of open flames near any solvent cleaning equipment shall be permitted only after such equipment has first been thoroughly cleared of solvents and vapors.

(12) **Vapor degreasing tanks.**

(a) In any vapor degreasing tank equipped with a condenser and vapor level thermostat, the condenser or thermostat shall keep the level of vapors below the top edge of the tank by a distance at least equal to one-half the tank width, or at least 36 inches, whichever is shorter.

(b) Where gas is used as a fuel for heating vapor degreasing tanks, the combustion chamber shall be of tight construction, except for such openings as the exhaust flue, and those that are necessary for supplying air for combustion. Flues shall be of corrosion-resistant construction and shall extend to the outer air. If mechanical exhaust is used on this flue, a draft diverter shall be used. Special precautions must be taken to prevent solvent fumes from entering the combustion air of this or any other heater when chlorinated or fluorinated hydrocarbon solvents (for example, trichloroethylene; Freon) are used.

(c) Heating elements shall be so designed and maintained that their surface temperature will not cause the solvent or mixture to decompose, break down, or be converted into an excessive quantity of vapor.

(d) Tanks or machines of more than 4 square feet of vapor area, used for solvent cleaning or vapor degreasing, shall be equipped with suitable cleanout or sludge doors located near the bottom of each tank or still. These doors shall be so designed and gasketed that there will be no leakage of solvent when they are closed.

WAC 296-62-11021 (Cont.)

(13) **Scope.**

(a) This paragraph applies to all operations involving the immersion of materials in liquids, or in the vapors of such liquids, for the purpose of cleaning or altering their surfaces, or adding or imparting a finish thereto, or changing the character of the materials, and their subsequent removal from the liquids or vapors, draining, and drying. Such operations include washing, electroplating, anodizing, pickling, quenching, dyeing, dipping, tanning, dressing, bleaching, degreasing, alkaline cleaning, stripping, rinsing, digesting, and other similar operations, but do not include molten materials handling operations, or surface coating operations.

(b) **"Molten materials handling operations"** means all operations, other than welding, burning, and soldering operations, involving the use, melting, smelting, or pouring of metals, alloys, salts, or other similar substances in the molten state. Such operations also include heat treating baths, descaling baths, die casting stereotyping, galvanizing, tinning, and similar operations.

(c) **"Surface coating operations"** means all operations involving the application of protective, decorative, adhesive, or strengthening coating or impregnation to one or more surfaces, or into the interstices of any object or material, by means of spraying, spreading, flowing, brushing, roll coating, pouring, cementing, or similar means; and any subsequent draining or drying operations, excluding open-tank operations.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-11021, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.010, .040, 050. 99-10 (Order 98-10) § 296-62-11021, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), 296-62-11021, filed 11/22/91, effective 12/24/91. RCW 49.17.040, 49.17.050, and 49.17.240. 81-16-015 (Order 81-20), 296-62-11021, filed 7/27/81; 80-11-010 (Order 80-14), 296-62-11021, filed 8/8/80; Order 73-3, 296-62-11021, filed 5/7/73.]

WAC 296-62-12007 Effective date. The effective date of WAC 296-62-12000 through 296-62-12009 shall be September 1, 1994.

[Statutory Authority: Chapter 49.17 RCW. 94-07-086 (Order 93-18), 296-62-12007, filed 3/16/94, effective 9/1/94.]

WAC 296-62-130 Emergency washing facilities.

(1) **Definitions.**

"Emergency washing facilities" means emergency showers, eyewashes, eye/face washes, hand-held drench hoses, or other similar units.

"Corrosive" is a substance that can cause destruction of living tissue by chemical action, including acids with a pH of 2.5 or below or caustics with a pH of 11.0 or above.

"Strong irritant" means a chemical that is not corrosive, but causes a strong temporary inflammatory effect on living tissue by chemical action at the site of contact.

"Toxic chemical" means a chemical that produces serious injury or illness by absorption through any body surface.

(2) Facilities required.

(a) What requirements apply to accessing emergency washing facilities?

- Emergency washing facilities must be readily available and accessible.
- To be readily available and accessible, emergency washing facilities must be free of obstruction and require no more than ten seconds to reach.
- The travel distance should be no farther than fifty feet (15.25 meters).

WAC 296-62-130 (Cont.)

(b) What requirements apply to emergency showers?

- Emergency showers must be provided if there is a potential for substantial portions of the body to come into contact with corrosives, strong irritants, or toxic chemicals.
- The emergency showers must deliver water to cascade over the user's entire body at a minimum rate of twenty gallons (75.7 liters) per minute for fifteen minutes or more.

(c) What requirements apply to emergency eyewash?

- Emergency eyewash must be provided where there is the potential for an employee's eyes to be exposed to corrosives, strong irritants, or toxic chemicals.
- The emergency eyewash equipment must irrigate and flush both eyes simultaneously while the operator holds the eyes open.
- The on-off valve must be activated in one second or less and must remain on without the use of the operator's hands until intentionally turned off.
- The emergency eyewash equipment must deliver at least 0.4 gallons (1.5 liters) of water per minute for fifteen minutes or more.

(d) What requirements apply to personal eyewash equipment?

- Personal eyewash units are portable, supplementary units that support plumbed units or self-contained units, or both, by delivering immediate flushing for less than fifteen minutes.
- Such units must deliver potable water or other medically approved eye flushing solution.
- Personal eyewash equipment may be used to supplement emergency washing facilities, however, they must not be used as a substitute.

(e) What are the requirements for hand-held drench hoses?

- Hand-held drench hoses are single-headed emergency washing devices connected to a flexible hose and can be used to irrigate and flush the face or other parts of the body.
- Hand-held drench hoses may be used to supplement emergency washing facilities, however, they must not be used as a substitute.
- Hand-held drench hoses must deliver at least 3.0 gallons (11.4 liters) or water per minute for fifteen minutes or more.

(f) What periodic inspection requirements apply to plumbed and self-contained washing equipment?

- All plumbed emergency eyewash facilities, and hand-held drench hoses must be activated weekly and inspected annually to ensure that they function correctly and that the quality and quantity of water is satisfactory for emergency washing purposes.
- Emergency showers must be activated and inspected annually to ensure that they function correctly and that the quality and quantity of water is satisfactory for emergency washing purposes.
- All self-contained eyewash equipment and personal eyewash equipment must be inspected and maintained according to manufacturer instructions. Inspections for proper operation must be done annually. Sealed personal eyewashes must be replaced after the manufacturer's expiration date.

Note: Most manufacturers recommend fluid replacement every six months in self-contained eyewashes. The ANSI Standard can be obtained from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

WAC 296-62-130 (Cont.)

(3) Potable water. All emergency washing facilities using notpotable water must have signs stating the water is nonpotable.

Note: For further information on the design, installation, and maintenance of emergency washing facilities, see American National Standards Institute (ANSI) publication Z358.1-1998, Emergency Eyewash and Shower Equipment. Emergency washing facilities that are designed to meet ANSI Z358.1-1998 also meet the requirements of this standard. The ANSI Standard can be obtained from the American National Standards Institute, 1430 Broadway, New York, New York 10018.

[Statutory Authority: RCW 49.17.040. 99-07-063 (Order 98-18), § 296-62-130, filed 03/17/99, effective 06/17/99. Statutory Authority: RCW 49.17.040 and 49.17.050. 85-10-004 (Order 85-09), 296-62-130, filed 4/19/85; Order 73-3, 296-62-130, filed 5/7/73; Order 70-8, 296-62-130, filed 7/31/70, effective 9/1/70; Rule 13.010, effective 8/1/63.]

PART M
CONFINED SPACES

WAC

WAC 296-62-141 Permit-required confined spaces.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-141, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14100 Scope and application.

(1) Scope. This part contains minimum requirements for practices and procedures to protect employees in all industries from the hazards of entry and/or work in permit-required confined spaces.

(2) Application. Part M (Permit-required confined spaces) applies to all employers under the jurisdiction of the Washington Industrial Safety and Health Act, chapter 49.17 RCW. Part M may be augmented by more protective requirements for confined spaces or areas in vertical standards. Certain industry specific vertical standards are more protective than chapter 296-62 WAC, Part M. Where there is a conflict between an industry specific vertical standard and chapter 296-62 WAC, Part M, the vertical standard will apply.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14100, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14105 Definitions.

"Acceptable entry conditions" means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

"Attendant" means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

"Authorized entrant" means an employee who is authorized by the employer to enter a permit space.

WAC 296-62-14105 (Cont.)

"Blanking or blinding" means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore. It is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

"Confined space" means a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work; and
- Has limited or restricted means for entry or exit (For example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry.); and
- Is not designed for continuous employee occupancy.

"Double block and bleed" means the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

"Emergency" means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

"Engulfment" means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be inhaled to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

"Entry" means the action by which a person passes through an opening into a permit-required confined space and includes work activities in that space. Entry is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space.

Note: If the opening is large enough for the worker to fully enter the space a permit is required even for partial body entry. Permits are not required for partial body entry where the opening is not large enough for full entry, although other standards such as lockout-tagout or respiratory protection may apply.

"Entry permit (permit)" means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in WAC 296-62-14509.

"Entry supervisor" means the person (such as the employer, crew leader, or crew chief) responsible for:

- Determining if acceptable entry conditions are present at a permit space where entry is planned;
- Authorizing entry and overseeing entry operations; and
- Terminating entry as required by this part.

Note: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

"Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

- Flammable gas, vapor, or mist in excess of ten percent of its lower flammable limit (LFL);
- Airborne combustible dust at a concentration that meets or exceeds its LFL;

WAC 296-62-14105 (Cont.)

Note: This concentration may be approximated as a condition in which the dust obscures vision at a distance of five feet (1.52 m) or less.

- Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
- Atmospheric concentration of any substance which may exceed a permissible exposure limit is published in chapter 296-62 WAC, Parts F, G, H, and I, general occupational health standards;

Note: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

- Any other atmospheric condition that is immediately dangerous to life or health.

Note: For air contaminants for which WISHA has not determined a dose or permissible exposure limit, other sources of information, such as material safety data sheets that comply with the hazard communication standard, chapter 296-62 WAC, Part C, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

"Hot work permit" means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

"Immediately dangerous to life or health (IDLH)" means any condition that:

- Poses an immediate or delayed threat to life; or
- Would cause irreversible adverse health effects; or
- Would interfere with an individual's ability to escape unaided from a permit space.

Note: Some materials - hydrogen fluoride gas and cadmium vapor, for example - may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

"Inerting" means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

Note: This procedure produces an IDLH oxygen-deficient atmosphere.

"Isolation" means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: Blanking or blinding; misaligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tagout of all sources of energy; or blocking or disconnecting all mechanical linkages.

"Line breaking" means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas, or any fluid at a volume, pressure, or temperature capable of causing injury.

"Nonpermit confined space" means a confined space that does not contain any physical hazards or any actual or potential atmospheric hazards capable of causing death or serious physical harm.

"Oxygen deficient atmosphere" means an atmosphere containing less than 19.5 percent oxygen by volume.

WAC 296-62-14105 (Cont.)

"Oxygen enriched atmosphere" means an atmosphere containing more than 23.5 percent oxygen by volume.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere;
- Contains a material that has the potential for engulfing an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section; or
- Contains any other recognized serious safety or health hazard.

"Permit-required confined space program (permit space program)" means the employer's overall program for:

- Controlling, and, where appropriate, for protecting employees from, permit space hazards; and
- Regulating employee entry into permit spaces.

"Permit system" means the employer's written procedure for:

- Preparing and issuing permits for entry; and
- Returning the permit space to service following termination of entry.

"Prohibited condition" means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

"Rescue service" means the personnel designated to rescue employees from permit spaces.

"Retrieval system" means the equipment (including a retrieval line, chest or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for nonentry rescue of persons from permit spaces.

"Testing" means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

Note: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14105, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14110 General requirements.

(1) The employer must evaluate the workplace to determine if confined spaces are present. A confined space must be assumed to be a permit-required space unless it can be documented to be a nonpermit-confined space as required in subsection (2) of this section.

Note: Proper application of the decision flow chart in WAC 296-62-14171, Appendix A, would facilitate compliance with this requirement.

(2) A confined space may be classified as a nonpermit-confined space under the following conditions and procedures:

(a) If the confined space poses no actual or potential atmospheric hazards.

WAC 296-62-14110 (Cont.)

(b) If the confined space has no other recognized health or safety hazards including engulfment in solid or liquid material, electrical shock, or moving parts.

(c) If all hazards within the space are eliminated without entry into the space, the confined space may be classified as a nonpermit confined space for as long as the hazards remain eliminated.

(d) If it is necessary to enter the confined space to eliminate hazards, it must be assumed to be a permit space and such entry must be performed under WAC 296-62-14115 through 296-62-14150. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a nonpermit confined space for as long as the hazards remain eliminated.

Note: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Subsections (6) and (7) of this section cover permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

(e) The employer must:

(i) Document that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination.

(ii) Make the certification available to each employee entering the space or to that employee's authorized representative.

(f) When there are changes in the use or configuration of a nonpermit confined space that might increase the hazards to entrants, the employer must reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

(g) If hazards arise within a confined space that has been classified as a nonpermit space under this subsection, each employee in the space must exit the space. The employer must then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with chapter 296-62 WAC, Part M.

(3) If the workplace contains permit-required confined spaces, the employer must inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

Note: A sign reading "DANGER-PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER" or using other similar language would satisfy the requirement for a sign.

(4) If the employer decides that its employees will not enter permit spaces, the employer must:

- Take effective measures to prevent its employees from entering the permit spaces; and
- Comply with subsections (1), (3), and (8) of this section.

(5) If the employer decides that its employees will enter permit spaces, the employer must:

(a) Follow the procedures outlined in WAC 296-62-14115 through 296-62-14155; and

(b) Develop and implement a written permit space program that complies with this part; and

WAC 296-62-14110 (Cont.)

(c) Make the written program available for inspection by employees and their authorized representatives.

(6) An employer may use the alternate entry procedures specified in subsection (7) of this section for entering a permit space under the following conditions:

(a) The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

(b) The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

(c) The employer develops or has monitoring and inspection data that supports the demonstrations required by (a) and (b) of this subsection;

(d) If an initial entry of the permit space is necessary to obtain the data required by (c) of this subsection, the entry must be performed in compliance with the permit required confined space procedures outlined in WAC 296-62-14115 through 296-62-14150; and

(e) The determinations and supporting data required by (a), (b), and (c) of this subsection are documented by the employer and are made available to each employee who enters the permit space or to that employee's authorized representative.

(7) Alternate procedures for entering permit confined spaces.

The following alternate procedures apply to entry into permit spaces that meet the conditions set forth in subsection (6) of this section.

(a) During permit space entry using these alternate procedures an employer need not comply with WAC 296-62-14115 through 296-62-14125 and WAC 296-62-14135 through 296-62-14150. Training and employee participation requirements of WAC 296-62-14130 and 296-62-14155 still apply.

(b) Any conditions making it unsafe to remove an entrance cover must be eliminated before the cover is removed.

(c) When entrance covers are removed, the opening must be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and will protect each employee working in the confined space from objects falling into the space.

(d) Before an employee enters the confined space, the internal atmosphere must be tested, with a calibrated direct-reading instrument, for the following conditions in the order given below:

Any employee who enters the space, or that employee’s authorized representative, must be provided an opportunity to observe the preentry testing required by this paragraph.

(i) Oxygen content,

(ii) Flammable gases and vapors, and

(iii) Potential toxic air contaminants.

WAC 296-62-14110 (Cont.)

(e) There must be no hazardous atmosphere within the space whenever any employee is inside the space.

(f) Continuous forced air ventilation must be used, as follows:

(i) An employee must not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

(ii) The forced air ventilation must:

- Be directed to ventilate the immediate areas where an employee is or will be present within the space; and
- Continue until all employees have left the space;

(iii) The air supply for the forced air ventilation must be from a clean source and may not increase the hazards in the space.

(g) The atmosphere within the space must be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this subsection.

(h) If a hazardous atmosphere is detected during entry:

(i) Each employee must leave the space immediately;

(ii) The space must be evaluated to determine how the hazardous atmosphere developed; and

(iii) Measures must be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

(i) The employer must verify that:

- The space is safe for entry; and
- The preentry measures required by (a), (b), and (c) of this subsection have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification is made before entry and available to each employee entering the space.

(8) When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer must:

(a) Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this standard;

(b) Inform the contractor of the hazards identified and the host employer's experience with each permit space to be entered;

(c) Inform the contractor of any precautions or procedures that the host employer requires for the protection of employees in or near permit spaces where contractor personnel will be working;

WAC 296-62-14110 (Cont.)

(d) Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by WAC 296-62-14115(11); and

(e) Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

(9) In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations must:

(a) Obtain any available information regarding permit space hazards and entry operations from the host employer;

(b) Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by WAC 296-62-14115(11); and

(c) Inform the host employer either through a debriefing or during the entry operation of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14110, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14115 Permit-required confined space program (permit space program). When the employer decides employees will enter a permit-required confined space, the employer must:

(1) Implement the measures necessary to prevent unauthorized entry;

(2) Identify and evaluate the hazards of permit spaces before employees enter them;

(3) Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

(a) Specify acceptable entry conditions;

(b) Provide each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;

(c) Isolate the permit space;

(d) Purge, inert, flush, or ventilate the permit space as necessary to eliminate or control atmospheric hazards;

(e) Provide pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

(f) Verify that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

(4) Provide the following equipment (specified in (a) through (i) of this subsection) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

WAC 296-62-14115 (Cont.)

(a) Testing and monitoring equipment needed to comply with subsection (5) of this section;

(b) Ventilating equipment needed to obtain acceptable entry conditions;

(c) Communications equipment necessary for compliance with WAC 296-62-14135(3) and 296-62-14140(5);

(d) Personal protective equipment when feasible engineering and work practice controls will not adequately protect employees;

(e) Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

(f) Barriers and shields as required by subsection (3)(d) of this section;

(g) Equipment, such as ladders, needed for safe entry and exit by authorized entrants;

(h) Rescue and emergency equipment needed to comply with subsection (9) of this section, except when the equipment is provided by rescue services; and

(i) Any other equipment necessary for safe entry into and rescue from permit spaces.

(5) Evaluate permit space conditions as follows when entry operations are conducted:

(a) Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin;

(b) If isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), preentry testing shall be performed to the extent feasible before entry is authorized. If entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

(c) Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations;

(d) When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors;

(e) Provide each authorized entrant or that employee's authorized representative an opportunity to observe the preentry and any subsequent testing or monitoring of permit spaces;

(f) Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate; and

(g) Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted in accord with this section.

WAC 296-62-14115 (Cont.)

Note: Atmospheric testing conducted in accordance with WAC 296-62-14172, Appendix B, would be considered as satisfying the requirements of this paragraph. For permit space operations in sewers, atmospheric testing conducted in accordance with Appendix B, as supplemented by WAC 296-62-14175, Appendix E, would be considered as satisfying the requirements of this subdivision.

(6) Provide at least one attendant outside the permit space into which entry is authorized during entry operations;

Note: Attendants may be assigned to monitor more than one permit space provided the duties described in WAC 296-62-14140 can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in WAC 296-62-14140 can be effectively performed for each permit space that is monitored. However, it is important to assess if it is appropriate or possible to have multiple permit spaces monitored by a single attendant or have attendants stationed at a location outside the monitored permit space. Due to the variability of permit space work environments, the appropriateness of how a permit space is monitored should be tailored to the requirements of the permit space and the work being performed.

(7) If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under WAC 296-62-14140;

(8) Designate the persons who are to have active roles (for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required by WAC 296-62-14130;

(9) Develop and implement procedures for:

- Summoning rescue and emergency services;
- Rescuing entrants from permit spaces;
- Providing necessary emergency services to rescued employees; and
- Preventing unauthorized personnel from attempting a rescue;

(10) Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this part;

(11) Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space, so they do not endanger each other;

(12) Develop and implement procedures (such as closing off a permit space and canceling the permit) to end the entry after entry operations have been completed;

(13) Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and

Note: Examples of circumstances requiring the review of the permit space program are: Any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

WAC 296-62-14115 (Cont.)

(14) Review the permit space program, using the canceled permits retained under WAC 296-62-14120(6) within one year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

Note: Employers may perform a single annual review covering all entries performed during a twelve-month period. If no entry is performed during a twelve-month period, no review is necessary.

Note: WAC 296-62-14173, Appendix C, presents examples of permit space programs that are considered to comply with the requirements of WAC 296-62-14115.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14115, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14120 Permit system.

(1) Before entry is authorized, the employer must document the completion of measures required by WAC 296-62-14115(3) by preparing an entry permit.

Note: WAC 296-62-14174, Appendix D, presents examples of permits whose elements are considered to comply with the requirements of this part.

(2) Before entry begins, the entry supervisor identified on the permit must sign the entry permit to authorize entry.

(3) The completed permit must be made available at the time of entry to all authorized entrants or their authorized representatives, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that preentry preparations have been completed.

(4) The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with WAC 296-62-14125(2).

(5) The entry supervisor must terminate entry and cancel the entry permit when:

(a) The entry operations covered by the entry permit have been completed; or

(b) A condition that is not allowed under the entry permit arises in or near the permit space.

(6) The employer must retain each canceled entry permit for at least one year to facilitate the review of the permit-required confined space program required by WAC 296-62-14115(14). Any problems encountered during an entry operation must be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14120, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14125 Required entry permit information. The entry permit that documents compliance with this standard and authorizes entry to a permit space must identify the following:

(1) The permit space to be entered;

(2) The purpose of the entry;

(3) The date and the authorized duration of the entry permit;

WAC 296-62-14125 (Cont.)

(4) The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the duration of the permit, which authorized entrants are inside the permit space;

Note: This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

(5) The personnel, by name, currently serving as attendants;

(6) The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry;

(7) The hazards of the permit space to be entered;

(8) The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;

Note: Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

(9) The acceptable entry conditions;

(10) The results of initial and periodic tests performed under WAC 296-62-14115(5), accompanied by the names or initials of the testers and by an indication of when the tests were performed;

(11) The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services;

(12) The communication procedures used by authorized entrants and attendants to maintain contact during the entry;

(13) Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this part;

(14) Any other necessary information, given the circumstances of the particular confined space, in order to ensure employee safety; and

(15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.

Note: See WAC 296-62-14174, Appendix D, for a sample entry permit form.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14125, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14130 Training.

(1) The employer must provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this standard.

(2) Training must be provided to each affected employee in the following instances:

(a) Before the employee is first assigned duties under this section;

WAC 296-62-14130 (Cont.)

(b) Before there is a change in assigned duties;

(c) Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

(d) Whenever the employer has reason to believe that:

- There are deviations from the permit space entry procedures required by WAC 296-62-14115(3); or
- There are inadequacies in the employee's knowledge or use of these procedures.

(3) The training must establish employee proficiency in the duties required by this standard and must introduce new or revised procedures, as necessary, for compliance with this part.

(4) The employer must certify that the training required by subsections (1) through (3) of this section has been accomplished. The certification must:

- Contain each employee's name, the signatures or initials of the trainers, and the dates of training;
- Be available for inspection by employees and their authorized representatives.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14130, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14135 Duties of authorized entrants. The employer must ensure that all authorized entrants:

(1) Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(2) Properly use equipment as required by WAC 296-62-14115(4);

(3) Communicate with the attendant as necessary to enable the attendant to:

- Monitor entrant status; and
- Alert entrants of the need to evacuate the space as required by WAC 296-62-14140(6);

(4) Alert the attendant whenever:

(a) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation; or

(b) The entrant detects a prohibited condition; and

(5) Exit from the permit space as quickly as possible whenever:

(a) An order to evacuate is given by the attendant or the entry supervisor;

(b) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation;

(c) The entrant detects a prohibited condition; or

(d) An evacuation alarm is activated.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14135, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14140 Duties of attendants. The employer must ensure that each attendant:

(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(2) Is aware of possible behavioral effects of hazard exposure in authorized entrants;

(3) Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under WAC 296-62-14125(4) accurately identifies who is in the permit space;

(4) Remains outside the permit space during entry operations until relieved by another attendant;

Note: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by WAC 296-62-14150(1) and if they have been relieved as required by subsection (4) of this section.

(5) Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under subsection (6) of this section;

(6) Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following conditions:

(a) If the attendant detects a prohibited condition;

(b) If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;

(c) If the attendant detects a situation outside the space that could endanger the authorized entrants; or

(d) If the attendant cannot effectively and safely perform all the duties required under this section;

(7) Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

(8) Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

(a) Warn the unauthorized persons that they must stay away from the permit space;

(b) Tell the unauthorized persons that they must exit immediately if they have entered the permit space; and

(c) Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;

(9) Performs nonentry rescues as specified by the employer's rescue procedure; and

(10) Performs no other duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14140, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14145 Duties of entry supervisors. The employer must ensure that each entry supervisor:

(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(2) Verifies, by checking:

- That the appropriate entries have been made on the permit;
- That all tests specified by the permit have been conducted; and
- That all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry to begin;

(3) Terminates the entry and cancels the permit as required by WAC 296-62-14120(5);

(4) Verifies that rescue services are available and that the means for summoning them are operable;

(5) Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

(6) Determines that entry operations remain consistent with terms of the entry permit and that acceptable entry conditions are maintained. This determination must be made whenever responsibility for a permit space entry operation is transferred and at regular intervals dictated by the hazards and operations performed within space.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14145, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14150 Rescue and emergency services.

(1) An employer who designates rescue and emergency services, under WAC 296-62-14115(9) of this part must:

(a) Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified;

Note: What will be considered timely will vary according to the specific hazards involved in each entry. For example, chapter 296-62 WAC, Part E, Respiratory protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.

(b) Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;

(c) Select a rescue team or service from those evaluated that:

(i) Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;

(ii) Is equipped for and proficient in performing the needed rescue services;

(d) Inform each rescue team or service of the hazards they may confront when called on to perform rescue at the site; and

WAC 296-62-14150 (Cont.)

(e) Provide the rescue team or service with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

Note: Nonmandatory WAC 296-62-14176, Appendix F, contains examples of criteria which employers can use in evaluating prospective rescue services.

(2) An employer whose employees have been designated to provide permit space rescue and emergency services must take the following measures.

(a) Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

(b) Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant, as provided by WAC 296-62-14130 and 296-62-14135;

(c) Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer must ensure that at least one member of the rescue team or service holding a current certification in first-aid and CPR is available; and

(d) Ensure that affected employees practice making permit space rescues at least once every twelve months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. These representative permit spaces must, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

(3) Nonentry rescue. To facilitate nonentry rescue, retrieval systems or methods must be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems must meet the following requirements.

(a) Each authorized entrant must use a chest or full-body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, or above the entrant's head or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant.

(b) Wristlets may be used in lieu of the chest or full-body harness if the employer can demonstrate that the use of a chest or full-body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

(c) The other end of the retrieval line must be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary.

(d) A mechanical device must be available to retrieve personnel from vertical type permit spaces more than five feet (1.52 m) deep.

(4) If an injured entrant is exposed to a substance for which a material safety data sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information must be made available to the medical facility treating the exposed entrant.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14150, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14155 Employee participation.

(1) Employers must consult with affected employees and their authorized representatives on the development and implementation of all aspects of the permit space program required by WAC 296-62-14503.

(2) Employers must make available to affected employees and their authorized representatives all information required to be developed by this part.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14155, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14170 Appendices to WAC 296-62-141--Permit-required confined spaces.

Note: Appendices A through F serve to provide information and nonmandatory guidelines to assist employers and employees in complying with the appropriate requirements of this part.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14170, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14171 Appendix A--Permit-required confined space decision flow chart.

WAC 296-62-14171 (Cont.)

WAC 296-62-14171 (Cont.)

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14171, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14172 Appendix B--Procedures for atmospheric testing. Atmospheric testing is required for two distinct purposes:

- Evaluation of the hazards of the permit space; and
- Verification that acceptable entry conditions into that space exist.

(1) Evaluation testing.

- The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space.
- Evaluation and interpretation of these data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., WISHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.,) based on evaluation of all serious hazards.

(2) Verification testing.

- The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions.
- Results of testing (i.e., actual concentration, etc.,) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

(3) Duration of testing. Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.

(4) Testing stratified atmospheres.

- When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately four feet (1.22 m) in the direction of travel and to each side.
- If a sampling probe is used, the entrant's rate of progress should be slowed to accommodate the sampling speed and detector response.

(5) Order of testing.

- A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere.
- Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors.
- If tests for toxic gases and vapors are necessary, they are performed last.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14172, filed 10/29/99, effective 02/01/2000.]]

WAC 296-62-14173 Appendix C--Examples of permit-required confined space programs.

Example 1. Workplace. Sewer entry.

(1) Potential hazards. The employees could be exposed to the following:

(a) Engulfment.

WAC 296-62-14173 (Cont.)

(b) Presence of toxic gases. Equal to or more than 10 ppm hydrogen sulfide measured as an eight-hour time-weighted average. If the presence of other toxic contaminants is suspected, specific monitoring programs will be developed.

(c) Presence of explosive/flammable gases. Equal to or greater than ten percent of the lower flammable limit (LFL).

(d) Oxygen deficiency. A concentration of oxygen in the atmosphere equal to or less than 19.5% by volume.

(2) Entry without permit/attendant:

(a) Certification.

- Sewers may be entered without the need for a written permit or attendant provided that the space can be maintained in a safe condition for entry by mechanical ventilation alone, as provided in WAC 296-62-14110(5).
- All sewers must be considered permit-required confined spaces until the preentry procedures demonstrate otherwise.
- Any employee required or permitted to precheck or enter a sewer must have successfully completed, as a minimum, the training as required by the following sections of these procedures.
- A written copy of operating and rescue procedures as required by these procedures must be at the worksite for the duration of the job.
- The sewer preentry checklist must be completed by the LEAD WORKER before entry into a sewer. This list verifies completion of items listed below. This checklist must be kept at the job site for duration of the job.
- If circumstances dictate an interruption in the work, the sewer must be reevaluated and a new checklist must be completed.

(b) Control of atmospheric and engulfment hazards.

(i) Pumps and lines.

- All pumps and lines which may reasonably cause contaminants to flow into the sewer must be disconnected, blinded and locked out, or effectively isolated by other means to prevent development of dangerous air contamination or engulfment.
- Not all laterals to sewers or storm drains require blocking. However, where experience or knowledge of industrial use indicates there is a reasonable potential for contamination of air or engulfment into an occupied sewer, then all affected laterals must be blocked.
- If blocking and/or isolation requires entry into the sewer the provisions for entry into a permit-required confined space must be implemented.

(ii) Surveillance. The surrounding area must be surveyed to avoid hazards such as drifting vapors from the tanks, piping, or sewers.

(iii) Testing.

- The atmosphere within the sewer will be tested to determine whether dangerous air contamination and/or oxygen deficiency exists.

WAC 296-62-14173 (Cont.)

- Detector tubes, alarm only gas monitors and explosion meters are examples of monitoring equipment that may be used to test sewer atmospheres.
- Testing must be performed by a LEAD WORKER who has successfully completed the gas detector training for the monitoring method to be used.
- The minimum parameters to be monitored are oxygen deficiency, LFL, and hydrogen sulfide concentration.
- A written record of the preentry test results must be made and kept at the worksite for the duration of the job.
- The supervisor will certify in writing, based upon the results of the preentry testing, that all hazards have been eliminated or controlled.
- Affected employees must be able to review the testing results.
- The most hazardous conditions will govern when work is being performed in two adjoining, connecting spaces.

(c) Entry procedures. Entry into and work within may proceed if:

- There are no nonatmospheric hazards present;
- The preentry tests show there is no dangerous air contamination and/or oxygen deficiency within the space and there is no reason to believe that any is likely to develop;
- Continuous testing of the atmosphere in the immediate vicinity of the workers within the space is accomplished;
- Workers will immediately leave the sewer when any of the gas monitor alarm set points are reached as defined; and
- Workers will not return to the area until a SUPERVISOR who has completed the gas detector training has used a direct reading gas detector to evaluate the situation and has determined that it is safe to enter.

(d) Rescue. Arrangements for rescue services are not required for entries that do not require a permit. See the rescue portion of subsection (3), below, for instructions regarding rescue planning where an entry permit is required.

(3) Entry permit required.

(a) Entry permits.

- All sewers are considered permit-required confined spaces until the preentry procedures demonstrate otherwise.
- Any employee required or permitted to precheck or enter a sewer must have successfully completed, as a minimum, the training as required by the following sections of these procedures.
- A written copy of operating and rescue procedures as required by these procedures must be at the worksite for the duration of the job.
- The sewer entry permit must be completed before approval can be given to enter a sewer.
- The permit verifies completion of items listed below.
- The permit must be kept at the job site for the duration of the job.
- If circumstances cause an interruption in the work or a change in the alarm conditions for which entry was approved, a new sewer entry permit must be completed.

(b) Control of atmospheric and engulfment hazards.

WAC 296-62-14173 (Cont.)

(i) Surveillance. The surrounding area must be surveyed to avoid hazards such as drifting vapors from tanks, piping or sewers.

(ii) Testing.

- The sewer atmosphere must be tested to determine whether dangerous air contamination and/or oxygen deficiency exists.
- A direct reading gas monitor must be used.
- Testing must be performed by a SUPERVISOR who has successfully completed the gas detector training for the monitoring method used.
- The minimum parameters to be monitored are oxygen deficiency, LFL and hydrogen sulfide concentration.
- A written record of the preentry test results must be made and kept at the worksite for the duration of the job.
- Affected employees must be able to review the testing results.
- The most hazardous conditions will govern when work is being performed in two adjoining, connected spaces.

(iii) Space ventilation.

- Mechanical ventilation systems, where applicable, must be set at one hundred percent outside air.
- Where possible, open additional manholes to increase air circulation.
- Use portable blowers to augment natural circulation if needed.
- After a suitable ventilating period, repeat the testing.
- Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated or controlled.

(c) Entry procedures. Under any of the following conditions:

- Testing demonstrates the existence of dangerous or deficient conditions and additional ventilation cannot reduce concentrations to safe levels;
- The atmosphere tests as safe but unsafe conditions can reasonably be expected to develop;
- It is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems and it is not practical or safe to deactivate such systems; or
- An emergency exists and it is not feasible to wait for preentry procedures to take effect.

The following procedures must be observed:

- All personnel must be trained.
- A self-contained breathing apparatus must be worn by any person entering the sewer.
- At least one worker must stand by the outside of the sewer ready to give assistance in case of emergency.
- The rescue workers must have a self-contained breathing apparatus available for immediate use.
- There must be at least one additional worker within sight or call of the standby worker.
- Continuous powered communications must be maintained between the worker within the sewer and standby personnel.

WAC 296-62-14173 (Cont.)

- If at any time there is any questionable action or nonmovement by the worker inside, a verbal check will be made. If there is no response or a questionable response, the worker will be removed immediately from the sewer.

Exception: *If the worker is disabled due to falling or impact, the worker must not be removed from the sewer unless there is immediate danger to the worker's life. Local rescue personnel must be notified immediately. The standby worker may not enter the sewer in this case, only trained rescue personnel (wearing self contained breathing apparatus) may enter to perform a rescue. A full-body harness with attached lifeline must be used by all workers entering the space with the free end of the line secured outside the entry opening. The standby worker must use the lifeline to attempt to rescue a disabled worker without entering the space and summon rescue services based on their assessment of the situation.*

- When practical, the full-body harness must suspend a person upright and a hoisting device or similar apparatus must be available for lifting workers out of the sewer.
- In any situation where their use may endanger the worker, use of a hoisting device or full-body harness and attached lifeline may be discontinued.
- When dangerous air contamination is attributable to flammable and/or explosive substances, lighting and electrical equipment must be Class 1, Division 1 rated per National Electrical Code and no ignition sources may be introduced into the area.
- Continuous gas monitoring must be performed during all sewer entry operations. If alarm conditions occur, entry personnel must exit the sewer and a new sewer entry permit issued.
- Rescue. Call the local rescue services for rescue. Where immediate hazards to injured personnel are present, workers at the site must implement emergency procedures without entering the sewer. Rescue entries into sewers must be made only by trained and properly equipped personnel.

Example 2. Workplace. Meat and poultry rendering plants.

Cookers and dryers are either batch or continuous in their operation. Multiple batch cookers are operated in parallel. When one unit of a multiple set is shut down for repairs, means are available to isolate that unit from the others which remain in operation.

Cookers and dryers are horizontal, cylindrical vessels equipped with a center, rotating shaft and agitator paddles or discs. If the inner shell is jacketed, it is usually heated with steam at pressures up to 150 psig (1034.25 kPa). The rotating shaft assembly of the continuous cooker or dryer is also steam heated.

(1) Potential hazards. The recognized hazards associated with cookers and dryers are the risk that employees could be:

(a) Struck or caught by rotating agitator;

(b) Engulfed in raw material or hot, recycled fat;

(c) Burned by steam from leaks into the cooker/dryer steam jacket or the condenser duct system if steam valves are not properly closed and locked out;

(d) Burned by contact with hot metal surfaces, such as the agitator shaft assembly, or inner shell of the cooker/dryer;

WAC 296-62-14173 (Cont.)

(e) Heat stress caused by warm atmosphere inside cooker/dryer;

(f) Slipping and falling on grease in the cooker/dryer;

(g) Electrically shocked by faulty equipment taken into the cooker/dryer;

(h) Burned or overcome by fire or products of combustion; or

(i) Overcome by fumes generated by welding or cutting done on grease covered surfaces.

(2) Permits.

- The supervisor in this case is always present at the cooker/dryer or other permit entry confined space when entry is made.
- The supervisor must follow the preentry isolation procedures described in the entry permit in preparing for entry, and ensure that the protective clothing, ventilating equipment and any other equipment required by the permit are at the entry site.

(3) Control of hazards. Mechanical.

- Lock out main power switch to agitator motor at main power panel.
- Affix tag to the lock to inform others that a permit entry confined space entry is in progress.

(4) Engulfment.

- Close all valves in the raw material blow line.
- Secure each valve in its closed position using chain and lock.
- Attach a tag to the valve and chain warning that a permit entry confined space entry is in progress.
- The same procedure must be used for securing the fat recycle valve.

(5) Burns and heat stress.

- Close steam supply valves to jacket and secure with chains and tags.
- Insert solid blank at flange in cooker vent line to condenser manifold duct system.
- Vent cooker/dryer by opening access door at discharge end and top center door to allow natural ventilation throughout the entry.
- If faster cooling is needed, use a portable ventilation fan to increase ventilation.
- Cooling water may be circulated through the jacket to reduce both outer and inner surface temperatures of cooker/dryers faster.
- Check air and inner surface temperatures in cooker/dryer to assure they are within acceptable limits before entering, or use proper protective clothing.

(6) Fire and fume hazards.

- Careful site preparation, such as cleaning the area within four inches (10.16 cm) of all welding or torch cutting operations, and proper ventilation are the preferred controls.
- All welding and cutting operations must be done in accordance with the requirements of chapter 296-24 WAC, Part I, Welding, cutting, and brazing.
- Proper ventilation may be achieved by local exhaust ventilation, or the use of portable ventilation fans, or a combination of the two practices.

WAC 296-62-14173 (Cont.)

(7) Electrical shock. Electrical equipment used in cooker/dryers must be in serviceable condition.

(8) Slips and falls. Remove residual grease before entering cooker/dryer.

(9) Attendant. The supervisor must be the attendant for employees entering cooker/dryers.

(10) Permit. The permit must specify how isolation must be done and any other preparations needed before making entry. This is especially important in parallel arrangements of cooker/dryers so that the entire operation need not be shut down to allow safe entry into one unit.

(11) Rescue. When necessary, the attendant must call the employer's trained rescue team or the local fire services as previously arranged.

Example 3. Workplace. Workplaces where tank cars, trucks, and trailers, dry-bulk tanks and trailers, railroad tank cars, and similar portable tanks are fabricated or serviced.

(1) During fabrication. These tanks and dry-bulk carriers are entered repeatedly throughout the fabrication process. These products are not configured identically, but the manufacturing processes by which they are made are very similar.

(a) Sources of hazards. In addition to the mechanical hazards arising from the risks that an entrant would be injured due to contact with components of the tank or the tools being used, there is also the risk that a worker could be injured by breathing fumes from welding materials or mists or vapors from materials used to coat the tank interior. In addition, many of these vapors and mists are flammable, so the failure to properly ventilate a tank could lead to a fire or explosion.

(b) Control of hazards.

(i) Welding. Local exhaust ventilation must be used to remove welding fumes once the tank or carrier is completed to the point that workers may enter and exit only through a manhole. (Follow the requirements of chapter 296-24 WAC, Part I, Welding, cutting and brazing, at all times.) Welding gas tanks may never be brought into a tank or carrier that is a permit entry confined space.

(ii) Application of interior coatings/linings.

- Atmospheric hazards must be controlled by forced air ventilation sufficient to keep the atmospheric concentration of flammable materials below ten percent of the lower flammable limit (LFL) (or lower explosive limit (LEL), whichever term is used locally).
- The appropriate respirators are provided and shall be used in addition to providing forced ventilation if the forced ventilation does not maintain acceptable respiratory conditions.

(c) Permits. Because of the repetitive nature of the entries in these operations, an “area entry permit” will be issued for a one-month period to cover those production areas where tanks are fabricated to the point that entry and exit are made using manholes.

(d) Authorization. Only the area supervisor may authorize an employee to enter a tank within the permit area. The area supervisor must determine that conditions in the tank trailer, dry-bulk trailer or truck, etc., meet permit requirements before authorizing entry.

WAC 296-62-14173 (Cont.)

(e) Attendant.

- The area supervisor must designate an employee to maintain communication by employer specified means with employees working in tanks to ensure their safety.
- The attendant may not enter any permit entry confined space to rescue an entrant or for any other reason, unless authorized by the rescue procedure and, and even then, only after calling the rescue team and being relieved by an attendant by another worker.

(f) Communications and observation.

- Communications between attendant and entrant(s) must be maintained throughout entry.
- Methods of communication that may be specified by the permit include voice, voice-powered radio, tapping or rapping codes on tank walls, signaling tugs on a rope, and the attendant's observation that work activities such as chipping, grinding, welding, spraying, etc., which require deliberate operator control continue normally.
- These activities often generate so much noise that the necessary hearing protection makes communication by voice difficult.

(g) Rescue procedures.

- Acceptable rescue procedures include entry by a team of employee-rescuers, use of public emergency services, and procedures for breaching the tank.
- The area permit specifies which procedures are available, but the area supervisor makes the final decision based on circumstances. (Certain injuries may make it necessary to breach the tank to remove a person rather than risk additional injury by removal through an existing manhole.
- However, the supervisor must ensure that no breaching procedure used for rescue would violate terms of the entry permit. For instance, if the tank must be breached by cutting with a torch, the tank surfaces to be cut must be free of volatile or combustible coatings within four inches (10.16 cm) of the cutting line and the atmosphere within the tank must be below the LFL.)

(h) Retrieval line and harnesses.

- The retrieval lines and harnesses generally required under this standard are usually impractical for use in tanks because the internal configuration of the tanks and their interior baffles and other structures would prevent rescuers from hauling out injured entrants.
- However, unless the rescue procedure calls for breaching the tank for rescue, the rescue team must be trained in the use of retrieval lines and harnesses for removing injured employees through manholes.

(2) Repair or service of “used” tanks and bulk trailers.

(a) Sources of hazards. In addition to facing the potential hazards encountered in fabrication or manufacturing, tanks or trailers which have been in service may contain residues of dangerous materials, whether left over from the transportation of hazardous cargoes or generated by chemical or bacterial action on residues of nonhazardous cargoes.

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(b) Control of atmospheric hazards. A "used" tank must be brought into areas where tank entry is authorized only after the tank has been emptied, cleansed (without employee entry) of any residues, and purged of any potential atmospheric hazards.

(c) Welding. In addition to tank cleaning for control of atmospheric hazards, coating and surface materials must be removed four inches (10.16 cm) or more from any surface area where welding or other torch work will be done and care taken that the atmosphere within the tank remains well below the LFL. (Follow the requirements of chapter 296-24 WAC, Part I, Welding, cutting and brazing, at all times.)

(d) Permits.

- An entry permit valid for up to one year must be issued prior to authorization of entry into used tank trailers, dry-bulk trailers or trucks.
- In addition to the preentry cleaning requirement, this permit must require the employee safeguards specified for new tank fabrication or construction permit areas.

(e) Authorization.

- Only the area supervisor may authorize an employee to enter a tank trailer, dry-bulk trailer or truck within the permit area.
- The area supervisor must determine that the entry permit requirements have been met before authorizing entry.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14173, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14174 Appendix D--Sample permits.

WAC 296-62-17174, Appendix D, Sample A

WAC 296-62-14174, Appendix D, Sample B

WAC 296-62-14175 Appendix E--Sewer system entry. Sewer entry differs in three vital respects from other permit entries:

- There rarely exists any way to completely isolate the space (a section of a continuous system) to be entered;
- Because isolation is not complete, the atmosphere may suddenly and unpredictably become lethally hazardous (toxic, flammable or explosive) from causes beyond the control of the entrant or employer; and
- Experienced sewer workers are especially knowledgeable in entry and work in their permit spaces because of their frequent entries. Unlike other employments where permit space entry is a rare and exceptional event, sewer workers' usual work environment is a permit space.

(1) Adherence to procedure. The employer should designate as entrants only employees who are thoroughly trained in the employer's sewer entry procedures and who demonstrate that they follow these entry procedures exactly as prescribed when performing sewer entries.

(2) Atmospheric monitoring. Entrants should be trained in the use of, and be equipped with, atmospheric monitoring equipment which sounds an audible alarm, in addition to its visual readout, whenever one of the following conditions is encountered:

- Oxygen concentration less than 19.5 percent; flammable gas or vapor at ten percent or more of the lower flammable limit (LFL); or
- Hydrogen sulfide or carbon monoxide at or above 10 ppm or 35 ppm, respectively, measured as an eight-hour time-weighted average.

Atmospheric monitoring equipment needs to be calibrated according to the manufacturer's instructions. The oxygen sensor/broad range sensor is best suited for initial use in situations where the actual or potential contaminants have not been identified, because broad range sensors, unlike substance-specific sensors, enable employers to obtain an overall reading of the hydrocarbons (flammables) present in the space.

However, such sensors only indicate that a hazardous threshold of a class of chemicals has been exceeded. They do not measure the levels of contamination of specific substances. Therefore, substance-specific devices, which measure the actual levels of specific substances, are best suited for use where actual and potential contaminants have been identified.

The measurements obtained with substance-specific devices are of vital importance to the employer when decisions are made concerning the measures necessary to protect entrants (such as ventilation or personal protective equipment) and the setting and attainment of appropriate entry conditions. However, the sewer environment may suddenly and unpredictably change, and the substance-specific devices may not detect the potentially lethal atmospheric hazards which may enter the sewer environment.

(a) Although WISHA considers the information and guidance provided above to be appropriate and useful in most sewer entry situations, the department emphasizes that each employer must consider the unique circumstances, including the predictability of the atmosphere, of the sewer permit spaces in the employer's workplace in preparing for entry. Only the employer can decide, based upon his or her knowledge of, and experience with permit spaces in sewer systems, what the best type of testing instrument may be for any specific entry operation.

(b) The selected testing instrument should be carried and used by the entrant in sewer line work to monitor the atmosphere in the entrant's environment, and in advance of the entrant's direction of movement, to warn the entrant of any deterioration in atmospheric condition. Where several entrants are working together in the same immediate location, one instrument, used by the lead entrant, is acceptable.

WAC 296-62-14175 (Cont.)

(3) Surge flow and flooding. Sewer crews should develop and maintain liaison, to the extent possible, with the local weather bureau and fire and emergency services in their area so that sewer work may be delayed or interrupted and entrants withdrawn whenever sewer lines might be suddenly flooded by rain or fire suppression activities, or whenever flammable or other hazardous materials are released into sewers during emergencies by industrial or transportation accidents.

(4) Special equipment. Entry into large bore sewers may require the use of special equipment. Such equipment might include such items as atmosphere monitoring devices with automatic audible alarms, escape self-contained breathing apparatus (ESCBA) with at least ten minute air supply (or other NIOSH approved self-rescuer), and waterproof flashlights, and may also include boats and rafts, radios and rope stand-offs for pulling around bends and corners as needed.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14175, filed 10/29/99, effective 02/01/2000.]

WAC 296-62-14176 Appendix F--Rescue team or rescue service evaluation criteria.

(1) This appendix provides guidance to employers in choosing an appropriate rescue service. It contains criteria that may be used to evaluate the capabilities both of prospective and current rescue teams. Before a rescue team can be trained or chosen, however, a satisfactory permit program, including an analysis of all permit-required confined spaces to identify all potential hazards in those spaces, must be completed. WISHA believes that compliance with all the provisions of chapter 296-62 WAC, Part M will enable employers to conduct permit space operations without recourse to rescue services in nearly all cases. However, experience indicates that circumstances will arise where entrants will need to be rescued from permit spaces. It is therefore important for employers to select rescue services or teams, either on-site or off-site, that are equipped and capable of minimizing harm to both entrants and rescuers if the need arises.

(2) For all rescue teams or services, the employer's evaluation should consist of two components:

- An initial evaluation, in which employers decide whether a potential rescue service or team is adequately trained and equipped to perform permit space rescues of the kind needed at the facility and whether such rescuers can respond in a timely manner; and
- A performance evaluation, in which employers measure the performance of the team or service during an actual or practice rescue.

For example, based on the initial evaluation, an employer may determine that maintaining an on-site rescue team will be more expensive than obtaining the services of an off-site team, without being significantly more effective, and decide to hire a rescue service. During a performance evaluation, the employer could decide, after observing the rescue service perform a practice rescue, that the service's training or preparedness was not adequate to effect a timely or effective rescue at his or her facility and decide to select another rescue service, or to form an internal rescue team.

(a) Initial evaluation.

(i) The employer should meet with the prospective rescue service to facilitate the evaluations required by WAC 296-62-14150 (1)(a) and (b).

- At a minimum, if an off-site rescue service is being considered, the employer must contact the service to plan and coordinate the evaluations required by the standard.
- Merely posting the service's number or planning to rely on the 911 emergency phone number to obtain these services at the time of a permit space emergency would not comply with WAC 296-62-14150(1).

WAC 296-62-14176 (Cont.)

(ii) The capabilities required of a rescue service vary with the type of permit spaces from which rescue may be necessary and the hazards likely to be encountered in those spaces. Answering the questions below will assist employers in determining whether the rescue service is capable of performing rescues in the permit spaces present at the employer's workplace.

(A) What are the needs of the employer with regard to response time (time for the rescue service to receive notification, arrive at the scene, and set up and be ready for entry)?

For example, if entry is to be made into an IDLH atmosphere, or into a space that can quickly develop an IDLH atmosphere (if ventilation fails or for other reasons), the rescue team or service would need to be standing by at the permit space. On the other hand, if the danger to entrants is restricted to mechanical hazards that would cause injuries (e.g., broken bones, abrasions) a response time of ten or fifteen minutes might be adequate.

(B) How quickly can the rescue team or service get from its location to the permit spaces from which rescue may be necessary?

Relevant factors to consider would include:

- The location of the rescue team or service relative to the employer's workplace;
- The quality of roads and highways to be traveled, potential bottlenecks or traffic congestion that might be encountered in transit;
- The reliability of the rescuer's vehicles; and
- The training and skill of its drivers.

(C) What is the availability of the rescue service?

- Is it unavailable at certain times of the day or in certain situations?
- What is the likelihood that key personnel of the rescue service might be unavailable at times?
- If the rescue service becomes unavailable while an entry is underway, does it have the capability of notifying the employer so that the employer can instruct the attendant to abort the entry immediately?

(D) Does the rescue service meet all the requirements of WAC 296-62-14150(2) of the standard?

- If not, has it developed a plan that will enable it to meet those requirements in the future?
- If so, how soon can the plan be implemented?

(E) For off-site services, is the service willing to perform rescues at the employer's workplace? (An employer may not rely on a rescuer who declines, for whatever reason, to provide rescue services.)

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(F) Is an adequate method for communications between the attendant, employer and prospective rescuer available so that a rescue request can be transmitted to the rescuer without delay? How soon after notification can a prospective rescuer dispatch a rescue team to the entry site?

(G) For rescues into spaces that may pose significant atmospheric hazards and from which rescue entry, patient packaging and retrieval cannot be safely accomplished in a relatively short time (fifteen to twenty minutes), employers should consider using airline respirators (with escape bottles) for the rescuers and to supply rescue air to the patient. If the employer decides to use SCBA, does the prospective rescue service have an ample supply of replacement cylinders and procedures for rescuers to enter and exit (or be retrieved) well within the SCBA's air supply limits?

(H) If the space has a vertical entry over five feet in depth, can the prospective rescue service properly perform entry rescues? Does the service have the technical knowledge and equipment to perform rope work or elevated rescue, if needed?

(I) Does the rescue service have the necessary skills in medical evaluation, patient packaging and emergency response?

(J) Does the rescue service have the necessary equipment to perform rescues, or must the equipment be provided by the employer or another source?

(b) Performance evaluation.

Rescue services are required by WAC 296-62-14150 (2)(c) of the standard to practice rescues at least once every twelve months, provided that the team or service has not successfully performed a permit space rescue within that time. As part of each practice session, the service should perform a critique of the practice rescue, or have another qualified party perform the critique, so that deficiencies in procedures, equipment, training, or number of personnel can be identified and corrected. The results of the critique, and the corrections made to respond to the deficiencies identified, should be given to the employer to enable it to determine whether the rescue service can quickly be upgraded to meet the employer's rescue needs or whether another service must be selected. The following questions will assist employers and rescue teams and services evaluate their performance.

(i) Have all members of the service been trained as permit space entrants, at a minimum, including training in the potential hazards of all permit spaces, or of representative permit spaces, from which rescue may be needed? Can team members recognize the signs, symptoms, and consequences of exposure to any hazardous atmospheres that may be present in those permit spaces?

(ii) Is every team member provided with, and properly trained in, the use and need for PPE, such as SCBA or fall arrest equipment, which may be required to perform permit space rescues in the facility? Is every team member properly trained to perform his or her functions and make rescues, and to use any rescue equipment, such as ropes and backboards, that may be needed in a rescue attempt?

(iii) Are team members trained in the first aid and medical skills needed to treat victims overcome or injured by the types of hazards that may be encountered in the permit spaces at the facility?

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(iv) Do all team members perform their functions safely and efficiently? Do rescue service personnel focus on their own safety before considering the safety of the victim?

(v) If necessary, can the rescue service properly test the atmosphere to determine if it is IDLH?

(vi) Can the rescue personnel identify information pertinent to the rescue from entry permits, hot work permits, and MSDSs?

(vii) Has the rescue service been informed of any hazards to personnel that may arise from outside the space, such as those that may be caused by future work near the space?

(viii) If necessary, can the rescue service properly package and retrieve victims from a permit space that has a limited size opening (less than twenty-four inches (60.9 cm) in diameter), limited internal space, or internal obstacles or hazards?

(ix) If necessary, can the rescue service safely perform an elevated (high angle) rescue?

(x) Does the rescue service have a plan for each of the kinds of permit space rescue operations at the facility? Is the plan adequate for all types of rescue operations that may be needed at the facility? Teams may practice in representative spaces, or in spaces that are "worst-case" or most restrictive with respect to internal configuration, elevation, and portal size. The following characteristics of a practice space should be considered when deciding whether a space is truly representative of an actual permit space:

(A) Internal configuration.

(I) Open -- There are no obstacles, barriers, or obstructions within the space. One example is a water tank.

(II) Obstructed -- The permit space contains some type of obstruction that a rescuer would need to maneuver around. An example would be a baffle or mixing blade. Large equipment, such as a ladder or scaffold, brought into a space for work purposes would be considered an obstruction if the positioning or size of the equipment would make rescue more difficult.

(B) Elevation.

(I) Elevated -- A permit space where the entrance portal or opening is above grade by four feet or more. This type of space usually requires knowledge of high angle rescue procedures because of the difficulty in packaging and transporting a patient to the ground from the portal.

(II) Nonelevated -- A permit space with the entrance portal located less than four feet above grade. This type of space will allow the rescue team to transport an injured employee normally.

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(C) Portal size.

(I) Restricted -- A portal of twenty-four inches or less in the least dimension. Portals of this size are too small to allow a rescuer to simply enter the space while using SCBA. The portal size is also too small to allow normal spinal immobilization of an injured employee.

(II) Unrestricted -- A portal of greater than twenty-four inches in the least dimension. These portals allow relatively free movement into and out of the permit space.

(D) Space access.

(I) Horizontal -- The portal is located on the side of the permit space. Use of retrieval lines could be difficult.

(II) Vertical -- The portal is located on the top of the permit space, so that rescuers must climb down, or the bottom of the permit space, so that rescuers must climb up to enter the space. Vertical portals may require knowledge of rope techniques, or special patient packaging to safely retrieve a downed entrant.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-22 (Order 99-10), § 296-62-14176, filed 10/29/99, effective 02/01/2000.]

PART N
COTTON DUST

WAC

WAC 296-62-14533 Cotton dust.

(1) **Scope and application.**

(a) This section, in its entirety, applies to the control of employee exposure to cotton dust in all workplaces where employees engage in yarn manufacturing, engage in slashing and weaving operations, or work in waste houses for textile operations.

(b) This section does not apply to the handling or processing of woven or knitted materials; to maritime operations covered by chapters 296-56 and 296-304 WAC; to harvesting or ginning of cotton; or to the construction industry.

(c) Only subsection (8) Medical surveillance, subsection (11) (b) Medical surveillance, subsection (11)(c) Availability, subsection (11)(d) Transfer of records, and Appendices B, C, and D of this section apply in all work places where employees exposed to cotton dust engage in cottonseed processing or waste processing operations.

(d) This section applies to yarn manufacturing and slashing and weaving operations exclusively using washed cotton (as defined by subsection (14) of this section) only to the extent specified by subsection (14) of this section.

(e) This section, in its entirety, applies to the control of all employees exposure to the cotton dust generated in the preparation of washed cotton from opening until the cotton is thoroughly wetted.

(f) This section does not apply to knitting, classing or warehousing operations except that employers with these operations, if requested by WISHA, shall grant WISHA access to their employees and workplaces for exposure monitoring and medical examinations for purposes of a health study to be performed by WISHA on a sampling basis.

(2) **Definitions applicable to this section:**

(a) **"Blow down"** - the cleaning of equipment and surfaces with compressed air.

(b) **"Blow off"** - the use of compressed air for cleaning of short duration and usually for a specific machine or any portion of a machine.

(c) **"Cotton dust"** - dust present in the air during the handling or processing of cotton, which may contain a mixture of many substances including ground-up plant matter, fiber, bacteria, fungi, soil, pesticides, noncotton plant matter and other contaminants which may have accumulated with the cotton during the growing, harvesting and subsequent processing or storage periods. Any dust present during the handling and processing of cotton through the weaving or knitting of fabrics, and dust present in other operations or manufacturing processes using raw or waste cotton fibers

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or cotton fiber byproducts from textile mills are considered cotton dust within this definition. Lubricating oil mist associated with weaving operations is not considered cotton dust.

(d) **"Director"** - the director of labor and industries or his authorized representative.

(e) **"Equivalent instrument"** - a cotton dust sampling device that meets the vertical elutriator equivalency requirements as described in subsection (4)(a)(iii) of this section.

(f) **"Lint-free respirable cotton dust"** - particles of cotton dust of approximately 15 microns or less aerodynamic equivalent diameter.

(g) **"Vertical elutriator cotton dust sampler" or "vertical elutriator"** - a dust sampler which has a particle size cut-off at approximately 15 microns aerodynamic equivalent diameter when operating at the flow rate of 7.4 ±0.2 liters per minute.

(h) **"Waste processing"** - waste recycling (sorting, blending, cleaning and willowing) and garnetting.

(i) **"Yarn manufacturing"** - all textile mill operations from opening to, but not including, slashing and weaving.

(3) **Permissible exposure limits and action levels.**

(a) Permissible exposure limits (PEL).

(i) The employer shall assure that no employee who is exposed to cotton dust in yarn manufacturing and cotton washing operations is exposed to airborne concentrations of lint-free respirable cotton dust greater than 200 $\mu g/m^3$ mean concentration, averaged over an eight-hour period, as measured by a vertical elutriator or an equivalent instrument.

(ii) The employer shall assure than no employee who is exposed to cotton dust in textile mill waste house operations or is exposed in yarn manufacturing to dust from "lower grade washed cotton" as defined in subsection (14)(e) of this section is exposed to airborne concentrations of lint-free respirable cotton dust greater than 500 $\mu g/m^3$ mean concentration, averaged over an eight-hour period, as measured by a vertical elutriator or an equivalent instrument.

(iii) The employer shall assure that no employee who is exposed to cotton dust in the textile processes known as slashing and weaving is exposed to airborne concentrations of lint-free respirable cotton dust greater than 750 μ/m^3 mean concentration, averaged over an eight-hour period, as measured by a vertical elutriator or an equivalent instrument.

(b) Action levels.

(i) The action level for yarn manufacturing and cotton washing operations is an airborne concentration of lint-free respirable cotton dust of 100 μ/m^3 mean concentration, averaged over an eight-hour period, as measured by a vertical elutriator or an equivalent instrument.

(ii) The action level for waste houses for textile operations is an airborne concentration of lint-free respirable cotton dust of 250 $\mu g/m^3$ mean concentration, averaged over an eight-hour period, as measured by a vertical elutriator or an equivalent instrument.

(iii) The action level for the textile processes known as slashing and weaving is an airborne concentration of lint-free respirable cotton dust of 375 $\mu g/m^3$ mean concentration,

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averaged over an eight-hour period, as measured by a vertical elutriator or an equivalent instrument.

(4) **Exposure monitoring and measurement.**

(a) General.

(i) For the purposes of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.

(ii) The sampling device to be used shall be either the vertical elutriator cotton dust sampler or an equivalent instrument.

(iii) If an alternative to the vertical elutriator cotton dust sampler is used, the employer shall establish equivalency by demonstrating that the alternative sampling devices:

(A) It collects respirable particulates in the same range as the vertical elutriator (approximately 15 microns);

(B) Replicate exposure data used to establish equivalency are collected in side-by-side field and laboratory comparisons; and

(C) A minimum of 100 samples over the range of 0.5 to 2 times the permissible exposure limit are collected, and ninety percent of these samples have an accuracy range of plus or minus twenty-five percent of the vertical elutriator reading with a ninety-five percent confidence level as demonstrated by a statistically valid protocol. (An acceptable protocol for demonstrating equivalency is described in Appendix E of this section.)

(iv) WISHA will issue a written opinion stating that an instrument is equivalent to a vertical elutriator cotton dust sampler if:

(A) A manufacturer or employer requests an opinion in writing and supplies the following information:

(I) Sufficient test data to demonstrate that the instrument meets the requirements specified in this paragraph and the protocol specified in Appendix E of this section;

(II) Any other relevant information about the instrument and its testing requested by WISHA; and

(III) A certification by the manufacturer or employer that the information supplied is accurate, and

(B) If WISHA finds, based on information submitted about the instrument, that the instrument meets the requirements for equivalency specified by this subsection.

(b) Initial monitoring. Each employer who has a place of employment within the scope of subsections (1)(a), (d) or (e) of this section shall conduct monitoring by obtaining measurements which are representative of the exposure of all employees to airborne concentrations of lint-free respirable cotton dust over an eight-hour period. The sampling program shall include at least one determination during each shift for each work area.

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(c) Periodic monitoring.

(i) If the initial monitoring required by (4)(b) of this section or any subsequent monitoring reveals employee exposure to be at or below the permissible exposure limit, the employer shall repeat the monitoring for those employees at least annually.

(ii) If the initial monitoring required by (4)(b) of this section or any subsequent monitoring reveals employee exposure to be above the PEL, the employer shall repeat the monitoring for those employees at least every six months.

(iii) Whenever there has been a production, process, or control change which may result in new or additional exposure to cotton dust, or whenever the employer has any other reason to suspect an increase in employee exposure, the employer shall repeat the monitoring and measurements for those employees affected by the change or increase.

(d) Employee notification.

(i) Within twenty working days after the receipt of monitoring results, the employer shall notify each employee in writing of the exposure measurements which represent that employee's exposure.

(ii) Whenever the results indicate that the employee's exposure exceeds the applicable permissible exposure limit specified in subsection (3) of this section, the employer shall include in the written notice a statement that the permissible exposure limit was exceeded and a description of the corrective action taken to reduce exposure below the permissible exposure limit.

(5) **Methods of compliance.**

(a) Engineering and work practice controls. The employer shall institute engineering and work practice controls to reduce and maintain employee exposure to cotton dust at or below the permissible exposure limit specified in subsection (3) of this section, except to the extent that the employer can establish that such controls are not feasible.

(b) Whenever feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the permissible exposure limit, the employer shall nonetheless institute these controls to immediately reduce exposure to the lowest feasible level, and shall supplement these controls with the use of respirators which shall comply with the provisions of subsection (6) of this section.

(c) Compliance program.

(i) Where the most recent exposure monitoring data indicates that any employee is exposed to cotton dust levels greater than the permissible exposure limit, the employer shall establish and implement a written program sufficient to reduce exposures to or below the permissible exposure limit solely by means of engineering controls and work practices as required by (a) of this subsection.

(ii) The written program shall include at least the following:

(A) A description of each operation or process resulting in employee exposure to cotton dust;

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(B) Engineering plans and other studies used to determine the controls for each process;

(C) A report of the technology considered in meeting the permissible exposure limit;

(D) Monitoring data obtained in accordance with subsection (4) of this section;

(E) A detailed schedule for development and implementation of engineering and work practice controls, including exposure levels projected to be achieved by such controls;

(F) Work practice program; and

(G) Other relevant information.

(iii) The employer's schedule as set forth in the compliance program, shall project completion of the implementation of the compliance program no later than March 27, 1984 or as soon as possible if monitoring after March 27, 1984 reveals exposures over the PEL, except as provided in (13)(b)(ii)(B) of this section.

(iv) The employer shall complete the steps set forth in his program by the dates in the schedule.

(v) Written programs shall be submitted, upon request, to the director, and shall be available at the worksite for examination and copying by the director, and any affected employee or their designated representatives.

(vi) The written programs required under subsection (5)(c) of this section shall be revised and updated at least every six months to reflect the current status of the program and current exposure levels.

(d) Mechanical ventilation. When mechanical ventilation is used to control exposure, measurements which demonstrate the effectiveness of the system to control exposure, such as capture velocity, duct velocity, or static pressure shall be made at reasonable intervals.

(6) **Use of respirators.**

(a) General. For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this section. Respirators must be used during:

(i) Periods necessary to install or implement feasible engineering controls and work-practice controls;

(ii) Maintenance and repair activities for which engineering and work-practice controls are not feasible;

(iii) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limits;

(iv) Work operations specified under subsection (7)(a) of this section;

(v) Periods for which an employee requests a respirator.

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(b) Respirator program.

(i) The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(ii) Whenever a physician determines that an employee who works in an area in which the cotton-dust concentration exceeds the PEL is unable to use a respirator, including a powered air-purifying respirator, the employee must be given the opportunity to transfer to an available position, or to a position that becomes available later, that has a cotton-dust concentration at or below the PEL. The employer must ensure that such employees retain their current wage rate or other benefits as a result of the transfer.

(c) Respirator selection.

(i) The employer must select the appropriate respirator from Table 1 of this section.

TABLE I

	Cotton dust concentration	**Respirator required**
	Not greater than--	
(a)	5 x the applicable permissible exposure limit (PEL).	A disposable respirator with a particulate filter.
(b)	10 x the applicable PEL>	A quarter or half-mask respirator, other than a disposable respirator, equipped with particulate filters.
(c)	100 x the applicable PEL	A full facepiece respirator equipped with high-efficiency particulate filters.
(d)	Greater than 100 x the applicable PEL	A powered air-purifying respirator equipped with high-efficiency particulate filters.

Notes

1. A disposable respirator means the filter element is an inseparable part of the respirator.

2. Any respirators permitted at higher environmental concentrations can be used at lower concentrations.
3. Self-contained breathing apparatus are not required respirators but are permitted respirators.
4. Supplied air respirators are not required but are permitted under the following conditions: Cotton dust concentration not greater than 10X the PEL--Any supplied air respirator; not greater than 100X the PEL--Any supplied air respirator with full facepiece, helmet or hood; greater than 100X the PEL--A supplied air respirator operated in positive pressure mode.

(ii) Whenever respirators are required by this section for cotton-dust concentrations that do not exceed the applicable permissible exposure limit by a multiple of 100 (100 x), the employer must, when requested by an employee, provide a powered air-purifying respirator with a high-efficiency particulate filter instead of the respirator specified in (a), (b), or (c) of Table 1 of this section.

(7) **Work practices.** Each employer shall, regardless of the level of employee exposure, immediately establish and implement a written program of work practices which shall minimize cotton dust exposure. The following shall be included where applicable:

(a) Compressed air "blow down" cleaning shall be prohibited, where alternative means are feasible. Where compressed air is used for cleaning, the employees performing the "blow down" or "blow off" shall wear suitable respirators. Employees whose presence is not required to perform "blow down" or "blow off" shall be required to leave the area affected by the "blow down" or "blow off" during this cleaning operation.

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(b) Cleaning of clothing or floors with compressed air shall be prohibited.

(c) Floor sweeping shall be performed with a vacuum or with methods designed to minimize dispersal of dust.

(d) In areas where employees are exposed to concentrations of cotton dust greater than the permissible exposure limit, cotton and cotton waste shall be stacked, sorted, baled, dumped, removed or otherwise handled by mechanical means, except where the employer can show that it is infeasible to do so. Where infeasible, the method used for handling cotton and cotton waste shall be the method which reduces exposure to the lowest level feasible.

(8) **Medical surveillance.**

(a) General.

(i) Each employer covered by the standard shall institute a program of medical surveillance for all employees exposed to cotton dust.

(ii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician and are provided without cost to the employee.

(iii) Persons other than licensed physicians, who administer the pulmonary function testing required by this section shall have completed a NIOSH approved training course in spirometry.

(b) Initial examinations. The employer shall provide medical surveillance to each employee who is or may be exposed to cotton dust. For new employees' this examination shall be provided prior to initial assignment. The medical surveillance shall include at least the following:

(i) A medical history;

(ii) The standardized questionnaire contained in WAC 296-62-14537; and

(iii) A pulmonary function measurement, including a determination of forced vital capacity (FVC) and forced expiratory volume in one second (FEV_1), the FEV_1/FVC ratio, and the percentage that the measured values of FEV_1 and FVC differ from the predicted values, using the standard tables in WAC 296-62-14539. These determinations shall be made for each employee before the employee enters the workplace on the first day of the work week, preceded by at least thirty-five hours of no exposure to cotton dust. The tests shall be repeated during the shift, no less than four hours and no more than ten hours after the beginning of the work shift; and, in any event, no more than one hour after cessation of exposure. Such exposure shall be typical of the employee's usual workplace exposure. The predicted FEV_1 and FVC for blacks shall be multiplied by 0.85 to adjust for ethnic differences.

(iv) Based upon the questionnaire results, each employee shall be graded according to Schilling's byssinosis classification system.

(c) Periodic examinations.

(i) The employer shall provide at least annual medical surveillance for all employees exposed to cotton dust above the action level in yarn manufacturing, slashing and weaving, cotton washing and waste house operations. The employer shall provide

medical surveillance at least every two years for all employees exposed to cotton dust at or below the action level, for all employees exposed to cotton dust from washed cotton (except from washed cotton defined in subsection (9)(c) of this section), and for all employees exposed to cotton dust in cottonseed processing and waste processing operations. Periodic medical surveillance shall include at least an update of the medical history, standardized questionnaire (Appendix B-111), Schilling byssinosis grade, and the pulmonary function measurements in (b)(iii) of this subsection.

(ii) Medical surveillance as required in (c)(i) of this subsection shall be provided every six months for all employees in the following categories:

(A) An FEV_1 of greater than eighty percent of the predicted value, but with an FEV_1 decrement of five percent or 200 ml. on a first working day;

(B) An FEV_1 of less than eighty percent of the predicted value; or

(C) Where, in the opinion of the physician, any significant change in questionnaire findings, pulmonary function results, or other diagnostic tests have occurred.

(iii) An employee whose FEV_1 is less than sixty percent of the predicted value shall be referred to a physician for a detailed pulmonary examination.

(iv) A comparison shall be made between the current examination results and those of previous examinations and a determination made by the physician as to whether there has been a significant change.

(d) Information provided to the physician. The employer shall provide the following information to the examining physician:

(i) A copy of this regulation and its appendices;

(ii) A description of the affected employee's duties as they relate to the employee's exposure;

(iii) The employee's exposure level or anticipated exposure level;

(iv) A description of any personal protective equipment used or to be used; and

(v) Information from previous medical examinations of the affected employee which is not readily available to the examining physician.

(e) Physician's written opinion.

(i) The employer shall obtain and furnish the employee with a copy of a written opinion from the examining physician containing the following:

(A) The results of the medical examination and tests including the FEV_1, FVC, and FEV_1/FVC ratio;

(B) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from exposure to cotton dust;

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(C) The physician's recommended limitations upon the employee's exposure to cotton dust or upon the employee's use of respirators including a determination of whether an employee can wear a negative pressure respirator, and where the employee cannot, a determination of the employee's ability to wear a powered air purifying respirator; and

(D) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(ii) The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposure.

(9) **Employee education and training.**

(a) Training program.

(i) The employer shall provide a training program for all employees exposed to cotton dust and shall assure that each employee is informed of the following:

(A) The acute and long term health hazards associated with exposure to cotton dust;

(B) The names and descriptions of jobs and processes which could result in exposure to cotton dust at or above the PEL.

(C) The measures, including work practices required by subsection (7) of this section, necessary to protect the employee from exposures in excess of the permissible exposure limit;

(D) The purpose, proper use, limitations, and other training requirements for respiratory protection as required by subsection (6) of this section and chapter 296-62 WAC, Part E (see WAC 296-62-07117, 296-62-07172, and 296-62-07186 through 296-62-07190);

(E) The purpose for and a description of the medical surveillance program required by subsection (8) of this section and other information which will aid exposed employees in understanding the hazards of cotton dust exposure; and

(F) The contents of this standard and its appendices.

(ii) The training program shall be provided prior to initial assignment and shall be repeated annually for each employee exposed to cotton dust, when job assignments or work processes change and when employee performance indicates a need for retraining.

(b) Access to training materials.

(i) Each employer shall post a copy of this section with its appendices in a public location at the workplace, and shall, upon request, make copies available to employees.

(ii) The employer shall provide all materials relating to the employee training and information program to the director upon request.

(10) **Signs.** The employer shall post the following warning sign in each work area where the permissible exposure limit for cotton dust is exceeded:

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WARNING
COTTON DUST WORK AREA
MAY CAUSE ACUTE OR DELAYED LUNG INJURY
(BYSSINOSIS)
RESPIRATORS REQUIRED IN THIS AREA

(11) **Recordkeeping.**

(a) Exposure measurements.

(i) The employer shall establish and maintain an accurate record of all measurements required by subsection (4) of this section.

(ii) The record shall include:

(A) A log containing the items listed in WAC 296-62-14535 (4)(a), and the dates, number, duration, and results of each of the samples taken, including a description of the procedure used to determine representative employee exposures;

(B) The type of protective devices worn, if any, and length of time worn; and

(C) The names, social security number, job classifications, and exposure levels of employees whose exposure the measurement is intended to represent.

(iii) The employer shall maintain this record for at least twenty years.

(b) Medical surveillance.

(i) The employer shall establish and maintain an accurate medical record for each employee subject to medical surveillance required by subsection (8) of this section.

(ii) The record shall include:

(A) The name and social security number and description of the duties of the employee;

(B) A copy of the medical examination results including the medical history, questionnaire response, results of all tests, and the physician's recommendation;

(C) A copy of the physician's written opinion;

(D) Any employee medical complaints related to exposure to cotton dust;

(E) A copy of this standard and its appendices, except that the employer may keep one copy of the standard and the appendices for all employees, provided that he references the standard and appendices in the medical surveillance record of each employee; and

(F) A copy of the information provided to the physician as required by subsection (8)(d) of this section.

(iii) The employer shall maintain this record for at least twenty years.

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(c) Availability.

(i) The employer shall make all records required to be maintained by subsection (11) of this section available to the director for examination and copying.

(ii) Employee exposure measurement records and employee medical records required by this subsection shall be provided upon request to employees, designated representatives, and the assistant director in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217.

(d) Transfer of records.

(i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by subsection (11) of this section.

(ii) Whenever the employer ceases to do business, and there is no successor employer to receive and retain the records for the prescribed period, these records shall be transmitted to the director.

(iii) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify the director at least three months prior to the disposal of such records and shall transmit those records to the director if he requests them within that period.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in WAC 296-62-05215.

(12) **Observation of monitoring.**

(a) The employer shall provide affected employees or their designated representatives an opportunity to observe any measuring or monitoring of employee exposure to cotton dust conducted pursuant to subsection (4) of this section.

(b) Whenever observation of the measuring or monitoring of employee exposure to cotton dust requires entry into an area where the use of personal protective equipment is required, the employer shall provide the observer with and assure the use of such equipment and shall require the observer to comply with all other applicable safety and health procedures.

(c) Without interfering with the measurement, observers shall be entitled to:

(i) An explanation of the measurement procedures;

(ii) An opportunity to observe all steps related to the measurement of airborne concentrations of cotton dust performed at the place of exposure; and

(iii) An opportunity to record the results obtained.

(13) **Washed cotton.**

(a) Exemptions. Cotton, after it has been washed by the processes described in this section is exempt from all or parts of this section as specified if the requirements of this section are met.

WAC 296-62-14533 (Cont.)

(b) Initial requirements.

(i) In order for an employer to qualify as exempt or partially exempt from this standard for operations using washed cotton, the employer must demonstrate that the cotton was washed in a facility which is open to inspection by the director and the employer must provide sufficient accurate documentary evidence to demonstrate that the washing methods utilized meet the requirements of this section.

(ii) An employer who handles or processes cotton which has been washed in a facility not under the employer's control and claims an exemption or partial exemption under this paragraph, must obtain from the cotton washer and make available at the worksite, to the director, or his designated representative, to any affected employee, or to their designated representative the following:

(A) A certification by the washer of the cotton of the grade of cotton, the type of washing process, and that the batch meets the requirements of this section:

(B) Sufficient accurate documentation by the washer of the cotton grades and washing process; and

(C) An authorization by the washer that the director may inspect the washer's washing facilities and documentation of the process.

(c) Medical and dyed cotton. Medical grade (USP) cotton, cotton that has been scoured, bleached and dyed, and mercerized yarn shall be exempt from all provisions of this standard.

(d) Higher grade washed cotton. The handling or processing of cotton classed as “low middling light spotted or better” (color grade 52 or better and leaf grade code 5 or better according to the 1993 USDA classification system) shall be exempt from all provisions of the standard except requirements of subsection (8) of this section, medical surveillance; subsection (11)(b) through (d) of this section, recordkeeping-medical records, and Appendices B, C, and D of this section, if they have been washed on one of the following systems:

(i) On a continuous batt system or a rayon rinse system including the following conditions:

(A) With water;

(B) At a temperature of no less than 60°C;

(C) With a water-to-fiber ratio of no less than 40:1; and

(D) With the bacterial levels in the wash water controlled to limit bacterial contamination of the cotton.

(ii) On a batch kier washing system including the following conditions:

(A) With water;

(B) With cotton fiber mechanically opened and thoroughly prewetted before forming the cake;

(C) For low-temperature processing, at a temperature of no less than 60°C with a water-to-fiber ratio of no less than 40:1; or, for high-temperature processing, at a temperature of no less than 93°C with a water-to-fiber ratio of no less than 15:1;

(D) With a minimum of one wash cycle followed by two rinse cycles for each batch, using fresh water in each cycle; and

(E) With bacterial levels in the wash water controlled to limit bacterial contamination of the cotton.

(e) Lower grade washed cotton. The handling and processing of cotton of grades lower than “low middling light spotted,” that has been washed as specified in (d) of this subsection and has also

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been bleached, shall be exempt from all provisions of the standard except the requirements of subsection (3)(a) Permissible exposure limits, subsection (4) Exposure monitoring and measurement, subsection (8) Medical surveillance, subsection (11) Recordkeeping, and Appendices B, C and D of this section.

(f) Mixed grades of washed cotton. If more than one grade of washed cotton is being handled or processed together, the requirements of the grade with the most stringent exposure limit, medical and monitoring requirements shall be followed.

(14) **Appendices.**

(a) Appendix B (B-I, B-II and B-III), WAC 296-62-14537, Appendix C, WAC 296-62-14539 and Appendix D, WAC 296-62-14541 are incorporated as part of this chapter and the contents of these appendices are mandatory.

(b) Appendix A of this chapter, WAC 296-62-14535 contains information which is not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

(c) Appendix E of this chapter is a protocol which may be followed in the validation of alternative measuring devices as equivalent to the vertical elutriator cotton dust sampler. Other protocols may be used if it is demonstrated that they are statistically valid, meet the requirements in subsection (4)(a)(iii) of this section, and are appropriate for demonstrating equivalency.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-19-065 (Order 01-15), § 296-62-14533, filed 09/18/01, effective 11/01/01. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) 21 296-62-14533, filed 05/04/99, effective 09/01/99.] Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-14533, filed 11/30/87. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-16-009 (Order 86-28), 296-62-14533, filed 7/25/86; 82-03-023 (Order 82-1), 296-62-14533, filed 1/15/82. Statutory Authority: 49.17.040, 49.17.050, and 49.17.240. 81-16-015 (Order 81-20), 296-62-14533, filed 7/27/81. Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), 296-62-14533, filed 11/13/80.]

WAC 296-62-14535 Appendix A--Air sampling and analytical procedures for determining concentrations of cotton dust.

(1) **Sampling locations.** The sampling procedures must be designed so that samples of the actual dust concentrations are collected accurately and consistently and reflect the concentrations of dust at the place and time of sampling. Sufficient number of six-hour area samples in each distinct work area of the plant should be collected at locations which provide representative samples of air to which the worker is exposed. In order to avoid filter overloading, sampling time may be shortened when sampling in dusty areas. Samples in each work area should be gathered simultaneously or sequentially during a normal operating period. The daily time-weighted average (TWA) exposure of each worker can then be determined by using the following formula:

$$\frac{\text{Summation of hours spent in each location and the dust concentration in that location.}}{\text{Total hours exposed}}$$

A time-weighted average concentration should be computed for each worker and properly logged and maintained on file for review.

(2) **Sampling equipment.**

(a) Sampler. The instrument selected for monitoring is the Lumsden-Lynch vertical elutriator. It should operate at a flow rate of 7.4 ±0.2 liters/minute. The samplers should be cleaned prior to sampling. The pumps should be monitored during sampling.

(b) Filter holder. A three-piece cassette constructed of polystyrene designed to hold a 37-mm diameter filter should be used. Care must be exercised to insure that an adequate seal exists between elements of the cassette.

(c) Filters and support pads. The membrane filters used should be polyvinyl chloride with a 5-um pore size and 37-mm diameter. A support pad, commonly called a backup pad, should be used under the filter membrane in the field monitor cassette.

(d) Balance. A balance sensitive to 10 micrograms should be used.

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(3) **Instrument calibration procedure.** Samplers shall be calibrated when first received from the factory, after repair, and after receiving any abuse. The samplers should be calibrated in the laboratory both before they are used in the field and after they have been used to collect a large number of field samples. The primary standard, such as a spirometer or other standard calibrating instruments such as a wet test meter or a large bubble meter or dry gas meter, should be used. Instructions for calibration with the wet test meter follow. If another calibration device is selected, equivalent procedures should be used:

(a) Level wet test meter. Check the water level which should just touch the calibration point at the left side of the meter. If water level is low, add water 1-2° F. warmer than room temperature of till point. Run the meter for thirty minutes before calibration;

(b) Place the polyvinyl chloride membrane filter in the filter cassette;

(c) Assemble the calibration sampling train;

(d) Connect the wet test meter to the train.

The pointer on the meter should run clockwise and a pressure drop of not more than 1.0 inch of water indicated. If the pressure drop is greater than 1.0, disconnect and check the system;

(e) Operate the system for ten minutes before starting the calibration;

(f) Check the vacuum gauge on the pump to insure that the pressure drop across the orifice exceeds seventeen inches of mercury;

(g) Record the following on calibration data sheets:

(i) Wet test meter reading, start and finish;

(ii) Elapsed time, start and finish (at least two minutes);

(iii) Pressure drop at manometer;

(iv) Air temperature;

(v) Barometric pressure; and

(vi) Limiting orifice number.

(h) Calculate the flow rate and compare against the flow of 7.4 ±0.2 liters/minute. If flow is between these limits, perform calibration again, average results, and record orifice number and flow rate. If flow is not within these limits, discard or modify orifice and repeat procedure;

(i) Record the name of the person performing the calibration, the date, serial number of the wet test meter, and the number of the critical orifices being calibrated.

(4) **Sampling procedure.**

(a) Sampling data sheets should include a log of:

(i) The date of the sample collection;

(ii) The time of sampling;

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(iii) The location of the sampler;

(iv) The sampler serial number;

(v) The cassette number;

(vi) The time of starting and stopping the sampling and the duration of sampling;

(vii) The weight of the filter before and after sampling;

(viii) The weight of dust collected (corrected for controls);

(ix) The dust concentration measured;

(x) Other pertinent information; and

(xi) Name of person taking sample.

(b) Assembly of filter cassette should be as follows:

(i) Loosely assemble three-piece cassette;

(ii) Number cassette;

(iii) Place absorbent pad in cassette;

(iv) Weigh filter to an accuracy of 10 μg;

(v) Place filter in cassette;

(vi) Record weight of filter in log, using cassette number for identification;

(vii) Fully assemble cassette, using pressure to force parts tightly together;

(viii) Install plugs top and bottom;

(ix) Put shrink band on cassette, covering joint between center and bottom parts of cassette; and

(x) Set cassette aside until shrink band dries thoroughly.

(c) Sampling collection should be performed as follows:

(i) Clean lint out of the motor and elutriator;

(ii) Install vertical elutriator in sampling locations specified above with inlet 4-1/2 to 5-1/2 feet from floor (breathing zone height);

(iii) Remove top section of cassette;

(iv) Install cassette in ferrule of elutriator;

(v) Tape cassette to ferrule with masking tape or similar material for air-tight seal;

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(vi) Remove bottom plug of cassette and attach hose containing critical orifice;

(vii) Start elutriator pump and check to see if gauge reads above 17 in. of Hg vacuum;

(viii) Record starting time, cassette number, and sampler number;

(ix) At end of sampling period stop pump and record time; and

(x) Controls with each batch of samples collected, two additional filter cassettes should be subjected to exactly the same handling as the samples, except that they are not opened. These control filters should be weighed in the same manner as the sample filters.

Any difference in weight in the control filters would indicate that the procedure for handling sample filters may not be adequate and should be evaluated to ascertain the cause of the difference, whether and what necessary corrections must be made, and whether additional samples must be collected.

(d) Shipping. The cassette with samples should be collected, along with the appropriate number of blanks, and shipped to the analytical laboratory in a suitable container to prevent damage in transit.

(e) Weighing of the sample should be achieved as follows:

(i) Remove shrink band;

(ii) Remove top and middle sections of cassette and bottom plug;

(iii) Remove filter from cassette and weigh to an accuracy of 10 æg; and

(iv) Record weight in log against original weight.

(f) Calculation of volume of air sampled should be determined as follows:

(i) From starting and stopping times of sampling period, determine length of time in minutes of sampling period; and

(ii) Multiply sampling time in minutes by flow rate of critical orifice in liters per minute and divide by 1000 to find air quantity in cubic meters.

(g) Calculation of dust concentrations should be made as follows:

(i) Subtract weight of clean filter from dirty filter and apply control correction to find actual weight of sample. Record this weight (in µg) in log; and

(ii) Divide mass of sample in µg by air volume in cubic meters to find dust concentration in µg/m. Record in log.

[Statutory Authority: RCW 49.17.040, 49.17.050, 49.17.240, chapters 42.30 and 43.22 RCW. 80-17-014 (Order 80-20), 296-62-14535, filed 11/13/80.]

WAC 296-62-14537 Appendix B-I through B-III--Respiratory questionnaire.

APPENDIX B-I
Respiratory Questionnaire

A. IDENTIFICATION DATA

Plant_____ Social Security No._____

Day Month (figures) Year (last 2 digits)

Name_____ Date of Interview_____
(Surname)
_____ Date of Birth_____
(First Names)

M F

Address_____ Age_____(8, 9) Sex_____ (10)

W	N	IND.	OTHER

_____ Race (11)

Interviewer: 1 2 3 4 5 6 7 8 (12)

Work Shift: 1st_____2nd_____3rd_____(13) **Standing Height_____(14, 15)**

Present Work Area **Weight_____(16, 18)**

If working in more than one specified work area, x area where most of the work shift is spent. If "other," but spending 25% of the work shift in one of the specified work areas, classify in that work area. If carding department employee, check area within that department where most of the work shift is being spent (if in doubt, check "throughout"). For work areas such as spinning and weaving where many work rooms may be involved, be sure to sure to check the specific work room to which the employee is assigned – if he works in more than one work room within a department classify as 7 (all) for that department.

	Workroom Number	(19) Open	(20) Pick	Area	(21) Card #1	(22) #2	(23) Spin	(24) Wind	(25) Twist	(26) Spool	(27) Warp	(28) Slash	(29) Weave	(30) Other
At Risk (cotton & cotton blend)	1			Cards										
	2			Draw										
	3			Comb										
	4			Rove										
	5			Thru Out										
	6													
	7 (all)													
Control (synthe-tic & Wool	8													
Ex-worker (cotton)	9													

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Use actual wording of each question. Put X in appropriate square after each question. When in doubt record 'No'. When no square, circle appropriate answer.

B. COUGH

(on getting up) ↑

Do you usually cough first thing in the morning?_____Yes_____ No_____ (31)
(Count a cough with first smoke or on "first going out of doors." exclude clearing throat or a single cough.)

Do you usually cough during the day or at night?_____Yes_____ No_____ (32)
(Ignore an occasional cough.)

If 'Yes' to either question (31, 32):

Do you cough like this on most days for as much as three months a year?_____Yes_____ No_____ (33)

Do you cough on any particular day of the week?_____Yes_____ No_____ (34)

(1) (2) (3) (4) (5) (6) (7)

If 'Yes': Which day? Mon. Tues. Wed. Thur. Fri. Sat. Sun.

_____ (35)

C. PHLEGM or alternative word to suit local custom.

(on getting up) ↑

Do you usually bring up any phlegm from your chest first thing in the morning? (Count phlegm with the first smoke or on "first going out of doors." Exclude phlegm from the nose. Count swallowed phlegm.)_____Yes_____ No_____(36)

Do you usually bring up any phlegm from your chest during the day or at night? (Accept twice or more.)_____Yes_____ No_____(37)

If 'Yes' to either question (36) or (37):

Do you bring up phlegm like this on most days for as much as three months each year?_____Yes_____ No_____(38)

If 'Yes' to question (33) or (38):

(cough)

How long have you had this phlegm? (39)

(Write in number of years)

(1) ☐ 2 years or less
(2) ☐ More than 2 years – 9 years
(3) ☐ 10 – 19 years
(4) ☐ 20+ years

↑These words are for subjects who work at night.

_____

D. CHEST ILLNESSES

In the past three years, have you had a period of (increased) ↑ cough and phlegm lasting for 3 weeks or more?_____ (40)

(1) ☐ No
(2) ☐ Yes, only one period
(3) ☐ Yes, two or more periods

↑For subjects who usually have phlegm

During the past three years have you had any chest illness which has kept you off work, indoors at home or in bed? (For as long as one week, flu?) Yes_____ No_____(41)

If 'Yes' to (41): Did you bring up (more) phlegm than usual in any of these illnesses? Yes_____ No_____(42)

If "Yes' to (42): During the past three years have you had:

Only one such illness with increased phlegm? (1) ☐ (43)

More than one illness: (2) ☐ (44)

Br. Grade_____

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E. TIGHTNESS

Does your chest ever feel tight or your breathing become difficult?_____ Yes_____ No_____(45)
Is your chest tight or your breathing difficult on any particular day of the week? (After a week or 10 days away from the mill)_____ Yes_____ No_____(46)

		(3)	(4)	(5)	(6)	(7)	(8)
If 'Yes' Which day?	**Mon.**	**Tues.**	**Wed.**	**Thur.**	**Fri.**	**Sat.**	**Sun.**

(1) Sometimes (2) Always

If 'Yes' Monday, At what time on Monday does your chest feel tight or your breathing difficult?
1. ☐ Before entering the mill (48)
2. ☐ After entering the mill

(Ask only if No to Question (45))

In the past, has your chest ever been tight or your breathing difficult on any particular day of the week?_____ Yes_____ No_____(49)

		(3)	(4)	(5)	(6)	(7)	(8)
If 'Yes' Which day?	**Mon.**	**Tues.**	**Wed.**	**Thur.**	**Fri.**	**Sat.**	**Sun.**

(1) Sometimes (2) Always

F. BREATHLESSNESS

If disabled from walking by any condition other than heart or lung disease put "X" here and leave questions (52-60) unasked ☐ (51)

Are you ever troubled by shortness of breath, when hurrying on the level or walking up a slight hill?_____ Yes_____ No_____ (52)
If 'No', grade is 1. If 'Yes', proceed to next question.

Do you get short of breath walking with other people at an ordinary pace on the level?_____ Yes_____ No_____ (53)
If 'No', grade is 2. If 'Yes', proceed to next question.

Do you have to stop for breath when walking at your own pace on the level?_____ Yes_____ No_____ (54)
If 'No', grade is 3. If 'Yes', proceed to next question.

Do you have to stop for breath on washing or dressing?_____ Yes_____ No_____ (55)
If 'No', grade is 4. If 'Yes', grade is 5.

Dyspnea Grd._____ (56)

ON MONDAYS

Are you ever troubled by shortness of breath, when hurrying on the level or walking up a slight hill?_____ Yes_____ No_____ (57)
If 'No', grade is 1. If 'Yes', proceed to the next question.

Do you get short of breath walking with other people at an ordinary pace on the level?_____ Yes_____ No_____ (58)
If "No', grade is 2. If 'Yes', proceed to the next question.

Do you have to stop for breath when walking at your own pace on the level?_____ Yes_____ No_____ (59)
If 'No', grade is 3. If 'Yes', proceed to the next question.

Are you short of breath on washing or dressing?_____ Yes_____ No_____ (60)
If "No', grade is 4. If 'Yes', grade is 5.

B. Grd_____ (61)

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G. OTHER ILLNESSES AND ALLERGY HISTORY

Do you have a heart condition for which you are under a doctor's care?_____ Yes_____ No_____ (62)

Have you ever had asthma? Yes_____ No_____ (63)

If 'Yes', did it begin (1) ☐ Before age 30 (2) ☐ After age 30

'Yes' before 30, did you have asthma before ever going to work in a textile mill?_____ Yes_____ No_____ (64)

Have you ever had hay fever or other allergies (other than above)?_____ Yes_____ No_____ (65)

H. TOBACCO SMOKING*

Do you smoke?

Record 'Yes' if regular smoker up to one month ago

(Cigarettes, cigar or pipe)_____ Yes_____ No_____ (66)

If 'No' to 63

Have you ever smoked? (Cigarettes, cigars, pipe. Record 'No' if subject has never smoked as much as one cigarette a day, or 1 oz. tobacco a month, for as long as one year.)_____ Yes_____ No_____ (67)

If 'Yes' to (63) or (64), what have you smoked and for how many years?
(Write in specific number of years in the appropriate square.)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Years	(<5)	(5 – 9)	(10 – 14)	(15 – 19)	(20 – 24)	(25 – 29)	(30 – 34)	(35 – 39)	(>40)	
Cigarettes										(68)
Pipe										(69)
Cigars										(70)

If cigarettes, how many packs per day? (1) ☐ less than 1/2 pack (2) ☐ 1/2 pack, but less than 1 pack (71)

(Write in number of cigarettes) (3) ☐ 1 pack, but less than 1-1/2 packs (4) ☐ 1-1/2 packs or more

Number of pack years: _____ (72) (73)

If an ex smoker (cigarettes, cigar or pipe). How long since you stopped_____ (74)

(Write in number of years) (1) ☐ 0-1 year (2) ☐ 1-4 years

(3) ☐ 5-9 years (4) ☐ 10+ years

Have you changed your smoking habits since last interview? If yes, specify what changes.

I. OCCUPATIONAL HISTORY**

Have you ever worked in A foundry? (As long as one year)_____ Yes_____ No_____ (75)

Stone or mineral mining, quarrying or processing (As long as one year)_____ Yes_____ No_____ (76)

Asbestos milling or processing? (Ever)_____ Yes_____ No_____ (77)

Other dusts, fumes or smoke? If yes, specify_____ Yes_____ No_____ (78)

Type of exposure_____

Length of exposure_____

**Ask only on first interview.

At what age do you first go to work in a textile mill? (Write in specific age in appropriate square)

<20	20-24	25-29	30-34	35-39	40+

When you first worked in a textile mill, did you work with (1) ☐ Cotton or cotton blend (79)

(2) ☐ Synthetic or wool (80)

WAC 296-62-14537 (Cont.)

APPENDIX B-II

Respiratory Questionnaire for Non Textile Workers for the Cotton Industry

_____

Identification No. **Interviewer Code**

_____

Location **Date of Interview**

_____

WAC 296-62-14537 (Cont.)

A. IDENTIFICATION

1. Name (Last) (First) (Middle Initial)		3. Phone Number Area Code ( ) No.	4. Social Security # (optional, see below) _____ - _____ - _____
2. Current Address (Number, Street, or Rural Route, City or Town, County, State, Zip Code)		5. Birthday (Mo., Day, Yr.)	6. Age Last Birthday
		7 Sex 1 ☐ Male 2 ☐ Female	
		8. Ethnic Group or Ancestry 1 ☐ White, not of Hispanic Origin 2 ☐ Black, not of Hispanic Origin 3 ☐ Hispanic 4 ☐ American Indian or Alaskan Native 5 ☐ Asian or Pacific Islander 6 ☐ Other:_____	
9. Standing Height _____(cm)	10. Weight _____	11. Work Shift 1st ☐ 2nd ☐ 3rd ☐	

12. Present Work Area
Please indicate primary assigned work area and percent of time spent at that site. If at other locations, please indicate and note percent of time for each.

Primary Work Area	_____
Specific Job	_____

13. Appropriate Industry

1 ☐ Garnetting 3 ☐ Cotton Warehouse 5 ☐ Cotton Classification
2 ☐ Cottonseed Oil Mill 4 ☐ Utilization 6 ☐ Cotton Ginning

(Furnishing your Social Security number is voluntary. Your refusal to provide this number will not affect any right, benefit, or privilege to which you would be entitled if you did provide your Social Security number. Your Social Security number is being requested since it will permit use in future determinators in statistical research studies.)

_____

WAC 296-62-14537 (Cont.)

B. OCCUPATIONAL HISTORY TABLE

Complete the following table showing the entire work history of the individual from present to initial employment. Sporadic, part-time periods of employment, each of no significant duration, should be grouped if possible.

Industry and Location	Tenure of Employment		Specific Occupation	Average No. Days Worked Per Week	Hazardous Health Exposure Associated With Work		
	From 19___	To 19___			Yes	No	If Yes, Describe

WAC 296-62-14537 (Cont.)

C. SYMPTOMS

Use actual wording of each question. Put X in appropriate square after each question. When in doubt record 'No'.

COUGH

1. Do you usually cough first thing in the morning?

(on getting up)* **1 ☐ Yes** **2 ☐ No**

(Count a cough with first smoke or on "first going out of doors". Exclude clearing throat or a single cough.)

2. Do you usually cough during the day or at night?

(Ignore an occasional cough.) **1 ☐ Yes** **2 ☐ No**

If YES to either question 1 or 2:

3. Do you cough like this on most days for as much as three months a year? **1 ☐ Yes** **2 ☐ No** **3 ☐ N/A**

4. Do you cough on any particular day of the week? **1 ☐ Yes** **2 ☐ No**

If YES:

5. Which day? **Mon.** **Tue.** **Wed.** **Thur.** **Fri.** **Sat.** **Sun.**

PHLEGM

6. Do you usually bring up phlegm from your chest first thing in the morning? (on getting up)* (Count phlegm with the first smoke or on "first going out of doors." Exclude phlegm from the nose. Count swallowed phlegm.) **1 ☐ Yes** **2 ☐ No**

7. Do you usually bring up phlegm from your chest during the day or at night?

(Accept twice or more) **1 ☐ Yes** **2 ☐ No**

If YES to either question 6 or 7:

8. Do you bring up phlegm like this on most days for as much as three months each year. **1 ☐ Yes** **2 ☐ No**

If YES to question 3 or 8:

9. How long have you had this phlegm? (cough)

Write in number of years)

(1) ☐ 2 years or less

(2) ☐ More than 2 years – 9 years

(3) ☐ 10-19 years

(4) ☐ 20+ years

***These words are for subjects who work at night**

WAC 296-62-14537 (Cont.)

10. In the past three years, have you had a period of (increased) cough and phlegm lasting for 3 weeks or more?

(1) ☐ No
(2) ☐ Yes, only one period
(3) ☐ Yes, two or more periods

For subjects who usually have phlegm:

11. During the past 3 years have you had any chest illness which has kept you off work, indoors at home in bed? (For as long as one week, flu?)

1 ☐ Yes 2 ☐ No

If YES to 11:

12. Did you bring up (more) phlegm than usual in any of these illnesses?

1 ☐ Yes 2 ☐ No

If YES to 12: During the past three years have you had:

13. Only one such illness with increased phlegm?

1 ☐ Yes 2 ☐ No

14. More than one such illness:

1 ☐ Yes 2 ☐ No
Br. Grade_____

TIGHTNESS

15. Does your chest ever feel tight or your breathing become difficult?

1 ☐ Yes 2 ☐ No

16. Is your chest tight or your breathing difficult on any particular day of the week? (after a week or 10 days from the pill)

If 'Yes' Which day?	Mon.	(3) Tues.	(4) Wed.	(5) Thur.	(6) Fri.	(7) Sat.	(8) Sun.

(1) Sometimes (2) Always

18. If YES Monday: At what time on Monday doe your chest feel tight or your breathing difficult?

☐ Before entering mill
☐ After entering mill

(ASK ONLY IF NOT TO QUESTION 15)

19. In the past, has your chest ever been tight or your breathing difficult on any particular day of the week?

1 ☐ Yes 2 ☐ No

If 'Yes' Which day?	Mon.	(3) Tues.	(4) Wed.	(5) Thur.	(6) Fri.	(7) Sat.	(8) Sun.

(1) Sometimes (2) Always

WAC 296-62-14537 (Cont.)

21. If disabled from walking by any condition other than heart or lung disease put "X" in the space and leave questions (20-30) unasked. ☐

22. Are you ever troubled by shortness of breath, when hurrying on the level or walking up slight hill? **1** ☐ **Yes** **2** ☐ **No**

If NO, grade is 1. If YES, proceed to next question.

23. Do you get short of breath walking with other people at an ordinary pace on the level? **1** ☐ **Yes** **2.** ☐ **No**

If NO, grade is 2. If YES, proceed to next question.

24. Do you have to stop for breath when walking at your own pace on the level? **1.** ☐ **Yes** **2.** ☐ **No**

If NO, grade is 3. If YES, proceed to next question.

25. Are you short of breath on washing or dressing? **1.** ☐ **Yes** **2.** ☐ **No**

If NO, grade is 4. If YES, grade is 5.

26. **Dyspnea Grd._____**

ON MONDAYS

27. Are you ever troubled by shortness of breath, when hurrying on the level or walking up a slight hill? **1.** ☐ **Yes** **2.** ☐ **No**

If NO, grade is 1. If YES, proceed to next question.

28. Do you get short of breath walking with other people at an ordinary pace on the level? **1.** ☐ **Yes** **2.** ☐ **No**

If NO, grade is 2. If YES, proceed to next question.

29. Do you have to stop for breath when walking at your own pace on the level? **1.** ☐ **Yes** **2.** ☐ **No**

If NO, grade is 3. If YES, proceed to next question.

30. Are you short of breath on washing or dressing? **1.** ☐ **Yes** **2.** ☐ **No**

If NO, grade is 4. If YES, grade is 5.

31. **B. Grd._____**

WAC 296-62-14537 (Cont.)

OTHER ILLNESSES AND ALLERGY HISTORY

32. Do you have a heart condition for which you are under a doctor's care? 1. ☐ Yes 2. ☐ No

33. Have you ever had asthma? 1. ☐ Yes 2. ☐ No

If yes, did it begin: (1) Before age 30 ☐
(2) After age 30 ☐

34. If yes before 30: did you have asthma before ever going to work in a textile mill? 1. ☐ Yes 2. ☐ No

35. Have you ever had hay fever or other allergies (other than above)? 1. ☐ Yes 2. ☐ No

36. Do you smoke: 1. ☐ Yes 2. ☐ No
Record Yes if regular smoker up to one month ago. (Cigarettes, cigar or pipe).

If NO to (33).

37. Have you ever smoked? (Cigarettes, cigars, pipe. Record NO if subject has never smoked as much as one cigarette a day, or 1 oz. of tabacco a month, for as long as one year.) 1. ☐ Yes 2. ☐ No

If Yes to (33) or (34): what have you smoked for how many years? (Write in specific number of years in the appropriate square)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Years	**(<5)**	**(5 – 9)**	**(10 – 14)**	**(15 – 19)**	**(20 – 24)**	**(25 – 29)**	**(30 – 34)**	**(35 – 39)**	**(>40)**
38. Cigarettes									
39. Pipe									
40. Cigars									

41. If cigarettes, how many packs per day?

(Write in number of cigarettes)

_____

☐ **less than 1/2 pack**
☐ **1/2 pack, but less than 1 pack (3)**
☐ **1 pack, but less than 1-1/2 packs**
☐ **1-1/2 packs or more**

42. Number of pack years: _____

43. If an ex smoker (cigarettes, cigar or pipe), how long since you stopped? Write in number of years.)

_____

☐ **0-1 year** ☐ **1-4 years**
☐ **5-9 years** ☐ **10+ years**

WAC 296-62-14537 Cont.)

OCCUPATIONAL HISTORY

Have you ever worked in:

44. A foundry? (As long as one year) **1.** ☐ **Yes** **2.** ☐ **No**

45. Stone or mineral mining, quarrying or processing?
(As long as one year) **1.** ☐ **Yes** **2.** ☐ **No**

46. Asbestos milling or processing? (Ever) **1.** ☐ **Yes** **2.** ☐ **No**

47. Cotton or cotton blend mill? (For controls only) **1.** ☐ **Yes** **2.** ☐ **No**

48. Other dusts, fumes or smoke: If yes, specify. **1.** ☐ **Yes** **2.** ☐ **No**

Type of exposure_____

Length of exposure_____

WAC 296-62-14537 (Cont.)

APPENDIX B-III
Abbreviated Respiratory Questionnaire.

A. IDENTIFICATION DATA

Plant_____ Social Security No._____

Day Month (figures) Year (last 2 digits)

Name_____ Date of Interview_____
(Surname)
_____ Date of Birth_____
(First Names)

Address_____ Age_____(8, 9) Sex_____ M F (10)

W	N	IND.	OTHER

_____ Race (11)

Interviewer: 1 2 3 4 5 6 7 8 (12)

Work Shift: 1st_____2nd_____3rd_____(13) **Standing Height_____(14, 15)**

Present Work Area **Weight_____(16, 18)**

If working in more than one specified work area, x area where most of the work shift is spent. If "other," but spending 25% of the work shift in one of the specified work areas, classify in that work area. If carding department employee, check area within that department where most of the work shift is being spent (if in doubt, check "throughout"). For work areas such as spinning and weaving where many work rooms may be involved, be sure to sure to check the specific work room to which the employee is assigned – if he works in more than one work room within a department classify as 7 (all) for that department.

	Workroom Number	(19) Open	(20) Pick	Area	(21) Card #1	(22) #2	(23) Spin	(24) Wind	(25) Twist	(26) Spool	(27) Warp	(28) Slash	(29) Weave	(30) Other
At Risk (cotton & cotton blend)	1			Cards										
	2			Draw										
	3			Comb										
	4			Rove										
	5			Thru Out										
	6													
	7 (all)													
Control (synthe-tic & Wool	8													
Ex-worker (cotton)	9													

WAC 296-62-14537 (Cont.)

Use actual wording of each question. Put X in appropriate square after each question. When in doubt record 'No'. When no square, circle appropriate answer.

B. COUGH

(on getting up) *

Do you usually cough first thing in the morning?_____Yes_____ No_____ (31)
(Count a cough with first smoke or on "first going out of doors." exclude clearing throat or a single cough.)

Do you usually cough during the day or at night?_____Yes_____ No_____ (32)
(Ignore an occasional cough.)

If 'Yes' to either question (31, 32):

Do you cough like this on most days for as much as three months a year?_____Yes_____ No_____ (33)
Do you cough on any particular day of the week?_____Yes_____ No_____ (34)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
If 'Yes': Which day?	**Mon.**	**Tues.**	**Wed.**	**Thur.**	**Fri.**	**Sat.**	**Sun.**

_____ (35)

C. PHLEGM or alternative word to suit local custom.

(on getting up)*

Do you usually bring up any phlegm from your chest first thing in the morning? (Count phlegm with the first smoke or on "first going out of doors." Exclude phlegm from the nose. Count swallowed phlegm.)_____Yes_____ No_____ (36)
Do you usually bring up any phlegm from your chest during the day or at night? (Accept twice or more.)_____Yes_____ No_____ (37)

If 'Yes' to either question ((36) or (37):

Do you bring up phlegm like this on most days for as much as three months each year?_____Yes_____ No_____ (38)

If 'Yes' to question (33) or (38):

(cough)

How long have you had this phlegm?

(Write in number of years)

(1) ☐ 2 years or less
(2) ☐ More than 2 years – 9 years
(3) ☐ 10 – 19 years
(4) ☐ 20+ years

***These words are for subjects who work at night.**

D. TIGHTNESS

Does your chest ever feel tight or your breathing become difficult?_____ Yes_____ No_____(39)
Is your chest tight or your breathing difficult on any particular day of the week? (After a week or 10 days away from the mill)_____ Yes_____ No_____(40)

		(3)	(4)	(5)	(6)	(7)	(8)
If 'Yes' Which day?	**Mon.**	**Tues.**	**Wed.**	**Thur.**	**Fri.**	**Sat.**	**Sun.**

(1)	(2)
Sometimes	**Always**

If 'Yes' Monday, At what time on Monday does your chest tight or your breathing difficult? (Ask only if No to Question (45)

1. ☐ Before entering the mill (42)
2. ☐ After entering the mill

WAC 296-62-14537 (Cont.)

In the past, has your chest ever been tight or your breathing difficult on any particular day of the week?_____ Yes_____ No_____(43)

If 'Yes' Which day?	**Mon.**	**(3) Tues.**	**(4) Wed.**	**(5) Thur.**	**(6) Fri.**	**(7) Sat.**	**(8) Sun.**

(1) Sometimes **(2) Always**

E. TOBACCO SMOKING

***Have you changed your smoking habits since last interview?**

If yes, specify what changes.

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-14537, filed 11/30/87.]

WAC 296-62-14539 Appendix C--Spirometry prediction tables for normal males and females.

TABLE 1. PREDICTED FVC FOR MALES (KNUDSON, ET AL.: AM. REV. RESPIR. DIS. 1976, 113, 587.)

	AGE											
HT	17	19	21	23	25	27	29	31	33	35	37	39
60.0	3.44	3.59	3.75	3.91	3.72	3.66	3.61	3.55	3.49	3.43	3.37	3.32
60.5	3.50	3.66	3.81	3.97	3.80	3.75	3.69	3.63	3.57	3.51	3.46	3.40
61.0	3.56	3.72	3.88	4.03	3.89	3.83	3.77	3.71	3.66	3.60	3.54	3.48
61.5	3.63	3.78	3.94	4.10	3.97	3.91	3.85	3.80	3.74	3.68	3.62	3.56
62.0	3.69	3.85	4.00	4.16	4.05	3.99	3.94	3.88	3.82	3.76	3.70	3.65
62.5	3.76	3.91	4.07	4.22	4.13	4.08	4.02	3.96	3.90	3.84	3.79	3.73
63.0	3.82	3.97	4.13	4.29	4.22	4.16	4.10	4.04	3.99	3.93	3.87	3.81
63.5	3.88	4.04	4.19	4.35	4.30	4.25	4.18	4.13	4.07	4.01	3.95	3.89
64.0	3.95	4.10	4.26	4.41	4.38	4.32	4.27	4.21	4.15	4.09	4.03	3.98
64.5	4.01	4.17	4.32	4.48	4.46	4.41	4.35	4.29	4.23	4.17	4.12	4.06
65.0	4.07	4.23	4.39	4.54	4.55	4.49	4.43	4.37	4.32	4.26	4.20	4.14
65.5	4.14	4.29	4.45	4.60	4.63	4.57	4.51	4.46	4.40	4.34	4.28	4.22
66.0	4.20	4.36	4.51	4.67	4.71	4.65	4.60	4.54	4.48	4.42	4.36	4.31
66.5	4.26	4.42	4.58	4.73	4.80	4.74	4.68	4.62	4.56	4.51	4.45	4.39
67.0	4.33	4.48	4.64	4.80	4.88	4.82	4.76	4.70	4.65	4.59	4.53	4.47
67.5	4.39	4.55	4.70	4.86	4.96	4.90	4.84	4.79	4.73	4.67	4.61	4.55
68.0	4.45	4.61	4.77	4.92	5.04	4.98	4.93	4.87	4.81	4.75	4.69	4.64
68.5	4.52	4.67	4.83	4.99	5.13	5.07	5.01	4.95	4.89	4.84	4.78	4.72
69.0	4.58	4.74	4.89	5.05	5.21	5.15	5.09	5.03	4.98	4.92	4.86	4.80
69.5	4.64	4.80	4.96	5.11	5.29	5.23	5.17	5.12	5.06	5.00	4.94	4.88
70.0	4.71	4.86	5.02	5.18	5.37	5.32	5.26	5.20	5.14	5.08	5.02	4.97
70.5	4.77	4.93	5.08	5.24	5.46	5.40	5.34	5.28	5.22	5.17	5.11	5.05
71.0	4.83	4.99	5.15	5.30	5.54	5.48	5.42	5.36	5.31	5.25	5.19	5.13
71.5	4.90	5.05	5.21	5.37	5.62	5.56	5.50	5.45	5.39	5.33	5.27	5.21
72.0	4.96	5.12	5.27	5.43	5.70	5.65	5.59	5.53	5.47	5.41	5.36	5.30
72.5	5.03	5.18	5.34	5.49	5.79	5.73	5.67	5.61	5.55	5.50	5.44	5.38
73.0	5.09	5.24	5.40	5.56	5.87	5.81	5.75	5.69	5.64	5.58	5.52	5.46
73.5	5.15	5.31	5.46	5.62	5.95	5.89	5.83	5.78	5.70	5.66	5.60	5.54
74.0	5.22	5.37	5.53	5.68	6.03	5.98	5.92	5.86	5.80	5.74	5.69	5.63
74.5	5.28	5.44	5.59	5.75	6.12	6.06	6.00	5.94	5.88	5.83	5.77	5.71
75.0	5.34	5.50	5.65	5.81	6.20	6.14	6.08	6.02	5.97	5.91	5.85	5.79
75.5	5.41	5.56	5.72	5.87	6.28	6.22	6.17	6.11	6.05	5.99	5.93	5.88
76.0	5.47	5.63	5.78	5.94	6.36	6.31	6.25	6.19	6.13	6.07	6.02	5.96
76.5	5.53	5.69	5.85	6.00	6.45	6.39	6.33	6.27	6.21	6.16	6.10	6.04
77.0	5.60	5.75	5.91	6.06	6.53	6.47	6.41	6.35	6.30	6.24	6.18	6.12
77.5	5.66	5.82	5.97	6.13	6.61	6.55	6.50	6.44	6.38	6.32	6.26	6.21
78.0	5.72	5.88	6.04	6.19	6.69	6.64	6.58	6.52	6.46	6.40	6.35	6.29
78.5	5.79	5.94	6.10	6.26	6.78	6.72	6.66	6.60	6.54	6.49	6.43	6.37
79.0	5.85	6.01	6.16	6.32	6.86	6.80	6.74	6.68	6.63	6.57	6.51	6.45
79.5	5.91	6.07	6.23	6.38	6.94	6.88	6.83	6.77	6.71	6.65	6.59	6.54
80.0	5.98	6.13	6.29	6.45	7.02	6.97	6.91	6.85	6.79	6.73	6.68	6.62
80.5	6.04	6.20	6.35	6.51	7.11	7.05	6.99	6.93	6.87	6.82	6.76	6.70
81.0	6.10	6.26	6.42	6.57	7.19	7.13	7.07	7.02	6.96	6.90	6.84	6.78
81.5	6.17	6.32	6.48	6.64	7.27	7.21	7.16	7.10	7.04	6.98	6.92	6.87
82.0	6.23	6.39	6.54	6.70	7.35	7.30	7.24	7.18	7.12	7.06	7.01	6.95
82.5	6.30	6.45	6.61	6.76	7.44	7.38	7.32	7.26	7.20	7.15	7.09	7.03
83.0	6.36	6.51	6.67	6.83	7.52	7.46	7.40	7.35	7.29	7.23	7.17	7.11
83.5	6.42	6.58	6.73	6.89	7.60	7.54	7.49	7.43	7.37	7.31	7.25	7.20
84.0	6.49	6.64	6.80	6.95	7.68	7.63	7.57	7.51	7.45	7.39	7.34	7.28
84.5	6.55	6.71	6.86	7.02	7.77	7.71	7.65	7.59	7.53	7.48	7.42	7.36
85.0	6.61	6.77	6.92	7.08	7.85	7.79	7.73	7.68	7.62	7.56	7.50	7.44

WAC 296-62-14539 Table 1 (Cont.)

	AGE												
HT	41	43	45	47	49	51	53	55	57	59	61	63	65
60.0	3.26	3.20	3.14	3.08	3.03	2.97	2.91	2.85	2.79	2.74	2.68	2.62	2.56
60.5	3.34	3.28	3.22	3.17	3.11	3.05	2.99	2.93	2.88	2.82	2.76	2.70	2.64
61.0	3.42	3.37	3.31	3.25	3.19	3.13	3.08	3.02	2.96	2.90	2.84	2.79	2.73
61.5	3.51	3.45	3.39	3.33	3.27	3.22	3.16	3.10	3.04	2.98	2.93	2.87	2.81
62.0	3.59	3.53	3.47	3.41	3.36	3.30	3.24	3.18	3.12	3.07	3.01	2.95	2.89
62.5	3.67	3.61	3.55	3.50	3.44	3.38	3.32	3.26	3.21	3.15	3.09	3.03	2.97
63.0	3.75	3.70	3.64	3.58	3.52	3.46	3.41	3.35	3.29	3.23	3.17	3.12	3.06
63.5	3.84	3.78	3.72	3.66	3.60	3.55	3.49	3.43	3.37	3.31	3.26	3.20	3.14
64.0	3.92	3.86	3.80	3.74	3.69	3.63	3.57	3.51	3.45	3.40	3.34	3.28	3.22
64.5	4.00	3.94	3.88	3.83	3.77	3.71	3.65	3.59	3.54	3.48	3.42	3.36	3.30
65.0	4.08	4.03	3.97	3.91	3.85	3.79	3.74	3.68	3.62	3.56	3.50	3.45	3.39
65.5	4.17	4.11	4.05	3.99	3.93	3.88	3.82	3.76	3.70	3.64	3.59	3.53	3.47
66.0	4.25	4.19	4.13	4.07	4.02	3.96	3.90	3.84	3.78	3.73	3.67	3.61	3.55
66.5	4.33	4.27	4.22	4.16	4.10	4.04	3.98	3.93	3.87	3.81	3.75	3.69	3.64
67.0	4.41	4.36	4.30	4.24	4.18	4.12	4.07	4.01	3.95	3.89	3.83	3.78	3.72
67.5	4.50	4.44	4.38	4.32	4.26	4.21	4.15	4.09	4.03	3.97	3.92	3.86	3.80
68.0	4.58	4.52	4.46	4.40	4.35	4.29	4.23	4.17	4.11	4.06	4.00	3.94	3.88
68.5	4.66	4.60	4.55	4.49	4.43	4.37	4.31	4.26	4.20	4.14	4.08	4.02	3.97
69.0	4.74	4.69	4.63	4.57	4.51	4.45	4.40	4.34	4.28	4.22	4.16	4.11	4.05
69.5	4.83	4.77	4.71	4.65	4.59	4.54	4.48	4.42	4.36	4.30	4.25	4.19	4.13
70.0	4.91	4.85	4.79	4.74	4.68	4.62	4.56	4.50	4.44	4.39	4.33	4.27	4.21
70.5	4.99	4.93	4.88	4.82	4.76	4.70	4.64	4.59	4.53	4.47	4.41	4.35	4.30
71.0	5.07	5.02	4.96	4.90	4.84	4.78	4.73	4.67	4.61	4.55	4.49	4.44	4.38
71.5	5.16	5.10	5.04	4.98	4.92	4.87	4.81	4.75	4.69	4.63	4.58	4.52	4.46
72.0	5.24	5.18	5.12	5.07	5.01	4.95	4.89	4.83	4.78	4.72	4.66	4.60	4.54
72.5	5.32	5.26	5.21	5.15	5.09	5.03	4.97	4.92	4.86	4.80	4.74	4.68	4.63
73.0	5.40	5.35	5.29	5.23	5.17	5.11	5.06	5.00	4.94	4.88	4.82	4.77	4.71
73.5	5.49	5.43	5.37	5.31	5.25	5.20	5.14	5.08	5.02	4.96	4.91	4.85	4.79
74.0	5.57	5.51	5.45	5.40	5.34	5.28	5.22	5.16	5.11	5.05	4.99	4.93	4.87
74.5	5.65	5.59	5.54	5.48	5.42	5.36	5.30	5.25	5.19	5.13	5.07	5.01	4.96
75.0	5.73	5.68	5.62	5.56	5.50	5.44	5.39	5.33	5.27	5.21	5.15	5.10	5.04
75.5	5.82	5.76	5.70	5.64	5.59	5.53	5.47	5.41	5.35	5.30	5.24	5.18	5.12
76.0	5.90	5.84	5.78	5.73	5.67	5.61	5.55	5.49	5.44	5.38	5.32	5.26	5.20
76.5	5.98	5.92	5.87	5.81	5.75	5.69	5.63	5.58	5.52	5.46	5.40	5.34	5.29
77.0	6.06	6.01	5.95	5.89	5.83	5.77	5.72	5.66	5.60	5.54	5.48	5.43	5.37
77.5	6.15	6.09	6.03	5.97	5.92	5.86	5.80	5.74	5.68	5.63	5.57	5.51	5.45
78.0	6.23	6.17	6.11	6.06	6.00	5.94	5.88	5.82	5.77	5.71	5.65	5.59	5.53
78.5	6.31	6.25	6.20	6.14	6.08	6.02	5.96	5.91	5.85	5.79	5.73	5.67	5.62
79.0	6.39	6.34	6.28	6.22	6.16	6.10	6.05	5.99	5.93	5.87	5.81	5.76	5.70
79.5	6.48	6.42	6.36	6.30	6.25	6.19	6.13	6.07	6.01	5.96	5.90	5.84	5.78
80.0	6.56	6.50	6.44	6.39	6.33	6.27	6.21	6.15	6.10	6.04	5.98	5.92	5.86
80.5	6.64	6.58	6.53	6.47	6.41	6.35	6.29	6.24	6.18	6.12	6.06	6.00	5.95
81.0	6.73	6.67	6.61	6.55	6.49	6.44	6.38	6.32	6.26	6.20	6.15	6.09	6.03
81.5	6.81	6.75	6.69	6.63	6.58	6.52	6.46	6.40	6.34	6.29	6.23	6.17	6.11
82.0	6.89	6.83	6.77	6.72	6.66	6.60	6.54	6.48	6.43	6.37	6.31	6.25	6.19
82.5	6.97	6.91	6.86	6.80	6.74	6.68	6.62	6.57	6.51	6.45	6.39	6.33	6.28
83.0	7.06	7.00	6.94	6.88	6.82	6.77	6.71	6.65	6.59	6.53	6.48	6.42	6.36
83.5	7.14	7.08	7.02	6.96	6.91	6.85	6.79	6.73	6.67	6.62	6.56	6.50	6.44
84.0	7.22	7.16	7.10	7.05	6.99	6.93	6.87	6.81	6.76	6.70	6.64	6.58	6.52
84.5	7.30	7.24	7.19	7.13	7.07	7.01	6.95	6.90	6.84	6.78	6.72	6.66	6.61
85.0	7.39	7.33	7.27	7.21	7.15	7.10	7.04	6.98	6.92	6.86	6.81	6.75	6.69

WAC 296-62-14539 (Cont.)

TABLE 2. PREDICTED FEV(1) FOR MALES (KNUDSON. ET AL.: AM. REV. RESPIR. DIS. 1976, 113, 587.)

	AGE											
HT	17	19	21	23	25	27	29	31	33	35	37	39
60.0	2.97	3.06	3.15	3.24	3.05	2.99	2.94	2.88	2.83	2.78	2.72	2.67
60.5	3.03	3.12	3.21	3.30	3.11	3.06	3.00	2.95	2.90	2.84	2.79	2.73
61.0	3.08	3.17	3.26	3.35	3.18	3.12	3.07	3.02	2.96	2.91	2.85	2.80
61.5	3.14	3.23	3.32	3.41	3.24	3.19	3.14	3.08	3.03	2.97	2.92	2.87
62.0	3.20	3.29	3.38	3.47	3.31	3.26	3.20	3.15	3.09	3.04	2.99	2.93
62.5	3.26	3.35	3.44	3.53	3.38	3.32	3.27	3.22	3.16	3.11	3.05	3.00
63.0	3.32	3.41	3.50	3.59	3.44	3.39	3.34	3.28	3.23	3.17	3.12	3.07
63.5	3.38	3.47	3.56	3.65	3.51	3.46	3.40	3.35	3.29	3.24	3.19	3.13
64.0	3.43	3.52	3.61	3.70	3.58	3.52	3.47	3.41	3.36	3.31	3.25	3.20
64.5	3.49	3.58	3.67	3.76	3.64	3.59	3.53	3.48	3.43	3.37	3.32	3.26
65.0	3.55	3.64	3.73	3.82	3.71	3.65	3.60	3.55	3.49	3.44	3.38	3.33
65.5	3.61	3.70	3.79	3.88	3.77	3.72	3.67	3.61	3.56	3.50	3.45	3.40
66.0	3.67	3.76	3.85	3.94	3.84	3.79	3.73	3.68	3.62	3.57	3.52	3.46
66.5	3.73	3.82	3.91	4.00	3.91	3.85	3.80	3.74	3.69	3.64	3.58	3.53
67.0	3.79	3.88	3.97	4.06	3.97	3.92	3.86	3.81	3.76	3.70	3.65	3.59
67.5	3.84	3.93	4.02	4.11	4.04	3.98	3.93	3.88	3.82	3.77	3.71	3.66
68.0	3.90	3.99	4.08	4.17	4.10	4.05	4.00	3.94	3.89	3.83	3.78	3.73
68.5	3.96	4.05	4.14	4.23	4.17	4.12	4.06	4.01	3.95	3.90	3.85	3.79
69.0	4.02	4.11	4.20	4.29	4.24	4.18	4.13	4.07	4.02	3.97	3.91	3.86
69.5	4.08	4.17	4.26	4.35	4.30	4.25	4.19	4.14	4.09	4.03	3.98	3.92
70.0	4.14	4.23	4.32	4.41	4.37	4.31	4.26	4.21	4.15	4.10	4.04	3.99
70.5	4.19	4.28	4.37	4.46	4.43	4.38	4.33	4.27	4.22	4.16	4.11	4.06
71.0	4.25	4.34	4.43	4.52	4.50	4.45	4.39	4.34	4.28	4.23	4.18	4.12
71.5	4.31	4.40	4.49	4.58	4.57	4.51	4.46	4.40	4.35	4.30	4.24	4.19
72.0	4.37	4.46	4.55	4.64	4.63	4.58	4.52	4.47	4.42	4.36	4.31	4.25
72.5	4.43	4.52	4.61	4.70	4.70	4.64	4.59	4.54	4.48	4.43	4.37	4.32
73.0	4.49	4.58	4.67	4.76	4.76	4.71	4.66	4.60	4.55	4.49	4.44	4.39
73.5	4.54	4.63	4.72	4.81	4.83	4.78	4.72	4.67	4.61	4.56	4.51	4.45
74.0	4.60	4.69	4.78	4.87	4.90	4.84	4.79	4.73	4.68	4.63	4.57	4.52
74.5	4.66	4.75	4.84	4.93	4.96	4.91	4.85	4.80	4.75	4.69	4.64	4.58
75.0	4.72	4.81	4.90	4.99	5.03	4.97	4.92	4.87	4.81	4.76	4.70	4.65
75.5	4.78	4.87	4.96	5.05	5.09	5.04	4.99	4.93	4.88	4.82	4.77	4.72
76.0	4.84	4.93	5.02	5.11	5.16	5.11	5.05	5.00	4.94	4.89	4.84	4.78
76.5	4.90	4.99	5.08	5.17	5.23	5.17	5.12	5.06	5.01	4.96	4.90	4.85
77.0	4.95	5.04	5.13	5.22	5.29	5.24	5.18	5.13	5.08	5.02	4.97	4.91
77.5	5.01	5.10	5.19	5.28	5.36	5.30	5.25	5.20	5.14	5.09	5.03	4.98
78.0	5.07	5.16	5.25	5.34	5.42	5.37	5.32	5.26	5.21	5.15	5.10	5.05
78.5	5.13	5.22	5.31	5.40	5.49	5.44	5.38	5.33	5.27	5.22	5.17	5.11
79.0	5.19	5.28	5.37	5.46	5.56	5.50	5.45	5.39	5.34	5.29	5.23	5.18
79.5	5.25	5.34	5.43	5.52	5.62	5.57	5.51	5.46	5.41	5.35	5.30	5.24
80.0	5.30	5.39	5.48	5.57	5.69	5.63	5.58	5.53	5.47	5.42	5.36	5.31
80.5	5.36	5.45	5.54	5.63	5.75	5.70	5.65	5.59	5.54	5.48	5.43	5.38
81.0	5.42	5.51	5.60	5.69	5.82	5.77	5.71	5.66	5.60	5.55	5.50	5.44
81.5	5.48	5.57	5.66	5.75	5.89	5.83	5.78	5.72	5.67	5.62	5.56	5.51
82.0	5.54	5.63	5.72	5.81	5.95	5.90	5.84	5.79	5.74	5.68	5.63	5.57
82.5	5.60	5.69	5.78	5.87	6.02	5.96	5.91	5.86	5.80	5.75	5.69	6.64
83.0	5.65	5.74	5.83	5.92	6.08	6.03	5.98	5.92	5.87	5.81	5.76	5.71
83.5	5.71	5.80	5.90	5.98	6.15	6.10	6.04	5.99	5.93	5.88	5.83	5.77
84.0	5.77	5.86	5.95	6.04	6.22	6.16	6.11	6.05	6.00	5.95	5.89	5.84
84.5	5.83	5.92	6.01	6.10	6.28	6.23	6.12	6.17	6.07	6.01	5.96	5.90
85.0	5.89	5.98	6.07	6.16	6.36	6.29	6.24	6.19	6.13	6.06	6.02	5.97

WAC 296-62-14539 Table 2 (Cont.)

	AGE												
HT	41	43	45	47	49	51	53	55	57	59	61	63	65
60.0	2.61	2.56	2.51	2.45	2.40	2.34	2.29	2.24	2.18	2.13	2.07	2.02	1.97
60.5	2.68	2.63	2.57	2.52	2.46	2.41	2.36	2.30	2.25	2.19	2.14	2.09	2.03
61.0	2.75	2.69	2.64	2.58	2.53	2.48	2.42	2.37	2.31	2.26	2.21	2.15	2.10
61.5	2.81	2.76	2.70	2.65	2.60	2.54	2.49	2.43	2.38	2.33	2.27	2.22	2.16
62.0	2.88	2.82	2.77	2.72	2.66	2.61	2.55	2.50	2.45	2.39	2.34	2.28	2.23
62.5	2.95	2.89	2.84	2.78	2.73	2.68	2.62	2.57	2.51	2.46	2.41	2.35	2.30
63.0	3.01	2.96	2.90	2.85	2.80	2.74	2.69	2.63	2.58	2.53	2.47	2.42	2.36
63.5	3.08	3.02	2.97	2.92	2.86	2.81	2.75	2.70	2.65	2.59	2.54	2.48	2.43
64.0	3.14	3.09	3.04	2.98	2.93	2.87	2.82	2.77	2.71	2.66	2.60	2.55	2.50
64.5	3.21	3.16	3.10	3.05	2.99	2.94	2.89	2.83	2.78	2.72	2.67	2.62	2.56
65.0	3.28	3.22	3.17	3.11	3.06	3.01	2.95	2.90	2.84	2.79	2.74	2.68	2.63
65.5	3.34	3.29	3.23	3.18	3.13	3.07	3.02	2.96	2.91	2.86	2.80	2.75	2.69
66.0	3.41	3.35	3.30	3.25	3.19	3.14	3.08	3.03	2.98	2.92	2.87	2.81	2.76
66.5	3.47	3.42	3.37	3.31	3.26	3.20	3.15	3.10	3.04	2.99	2.93	2.88	2.83
67.0	3.54	3.49	3.43	3.38	3.32	3.27	3.22	3.16	3.11	3.05	3.00	2.95	2.89
67.5	3.61	3.55	3.50	3.44	3.39	3.34	3.28	3.23	3.17	3.12	3.07	3.01	2.96
68.0	3.67	3.62	3.56	3.51	3.46	3.40	3.35	3.29	3.24	3.19	3.13	3.08	3.02
68.5	3.74	3.68	3.63	3.58	3.52	3.47	3.41	3.36	3.31	3.25	3.20	3.14	3.09
69.0	3.80	3.75	3.70	3.64	3.59	3.53	3.48	3.43	3.37	3.32	3.26	3.21	3.16
69.5	3.87	3.82	3.76	3.71	3.65	3.60	3.55	3.49	3.44	3.38	3.33	3.28	3.22
70.0	3.94	3.88	3.83	3.77	3.72	3.67	3.61	3.56	3.50	3.45	3.40	3.34	3.29
70.5	4.00	3.95	3.89	3.84	3.79	3.73	3.68	3.62	3.57	3.52	3.46	3.41	3.35
71.0	4.07	4.01	3.96	3.91	3.85	3.80	3.74	3.69	3.64	3.58	3.53	3.47	3.42
71.5	4.13	4.08	4.03	3.97	3.92	3.86	3.81	3.76	3.70	3.65	3.59	3.54	3.49
72.0	4.20	4.15	4.09	4.04	3.98	3.93	3.88	3.82	3.77	3.71	3.66	3.61	3.55
72.5	4.27	4.21	4.16	4.10	4.05	4.00	3.94	3.89	3.83	3.78	3.73	3.67	3.62
73.0	4.33	4.28	4.22	4.17	4.12	4.06	4.01	3.95	3.90	3.85	3.79	3.74	3.68
73.5	4.40	4.34	4.29	4.24	4.18	4.13	4.07	4.02	3.97	3.91	3.86	3.80	3.75
74.0	4.46	4.41	4.36	4.30	4.25	4.19	4.14	4.09	4.03	3.98	3.92	3.87	3.82
74.5	4.53	4.48	4.42	4.37	4.31	4.26	4.21	4.15	4.10	4.04	3.99	3.94	3.88
75.0	4.60	4.54	4.49	4.43	4.38	4.33	4.27	4.22	4.16	4.11	4.06	4.00	3.95
75.5	4.66	4.61	4.55	4.50	4.45	4.39	4.34	4.28	4.23	4.18	4.12	4.07	4.01
76.0	4.73	4.67	4.62	4.57	4.51	4.46	4.40	4.35	4.30	4.24	4.19	4.13	4.08
76.5	4.79	4.74	4.69	4.63	4.58	4.52	4.47	4.42	4.36	4.31	4.25	4.20	4.15
77.0	4.86	4.81	4.75	4.70	4.64	4.59	4.54	4.48	4.43	4.37	4.32	4.27	4.21
77.5	4.93	4.87	4.82	4.76	4.71	4.66	4.60	4.55	4.49	4.44	4.39	4.33	4.28
78.0	4.99	4.94	4.88	4.83	4.78	4.72	4.67	4.61	4.56	4.51	4.45	4.40	4.34
78.5	5.06	5.00	4.95	4.90	4.84	4.79	4.73	4.68	4.63	4.57	4.52	4.46	4.41
79.0	5.12	5.07	5.02	4.96	4.91	4.85	4.80	4.75	4.69	4.64	4.58	4.53	4.48
79.5	5.19	5.14	5.08	5.03	4.97	4.92	4.87	4.81	4.76	4.70	4.65	4.60	4.54
80.0	5.26	5.20	5.15	5.09	5.04	4.99	4.93	4.88	4.82	4.77	4.72	4.66	4.61
80.5	5.32	5.27	5.21	5.16	5.11	5.05	5.00	4.94	4.89	4.84	4.78	4.73	4.67
81.0	5.39	5.33	5.28	5.23	5.17	5.12	5.06	5.01	4.96	4.90	4.85	4.79	4.74
81.5	5.45	5.40	5.35	5.29	5.24	5.18	5.13	5.08	5.02	4.97	4.91	4.86	4.81
82.0	5.52	5.47	5.41	5.36	5.30	5.25	5.20	5.14	5.09	5.03	4.98	4.93	4.87
82.5	5.59	5.53	5.48	5.42	5.37	5.32	5.26	5.21	5.15	5.10	5.05	4.99	4.94
83.0	5.65	5.60	5.54	5.49	5.44	5.38	5.33	5.27	5.22	5.17	5.11	5.06	5.00
83.5	5.72	5.66	5.61	5.56	5.50	5.45	5.39	5.34	5.29	5.23	5.18	5.12	5.07
84.0	5.78	5.73	5.68	5.62	5.57	5.51	5.46	5.41	5.35	5.30	5.24	5.19	5.14
84.5	5.85	5.80	5.74	5.69	5.63	5.58	5.53	5.47	5.42	5.36	5.31	5.26	5.20
85.0	5.92	5.86	5.81	5.75	5.70	5.65	5.59	5.54	5.58	5.43	5.38	5.32	5.27

WAC 296-62-14539 (Cont.)

TABLE 3. PREDICTED FVC FOR FEMALES (KNUDSON, ETAL.: AM. REV .RESPIR .DIS.1976,113,587.)

	AGE											
HT	17	19	21	23	25	27	29	31	33	35	37	39
52.0	2.45	2.64	2.65	2.61	2.56	2.52	2.47	2.43	2.39	2.34	2.30	2.25
52.5	2.50	2.68	2.70	2.65	2.61	2.57	2.52	2.48	2.43	2.39	2.35	2.30
53.0	2.54	2.72	2.74	2.70	2.66	2.61	2.57	2.52	2.48	2.44	2.39	2.35
53.5	2.58	2.76	2.79	2.75	2.70	2.66	2.62	2.57	2.53	2.48	2.44	2.40
54.0	2.62	2.81	2.84	2.79	2.75	2.71	2.66	2.62	2.57	2.53	2.49	2.44
54.5	2.66	2.85	2.89	2.84	2.80	2.75	2.71	2.67	2.62	2.58	2.53	2.49
55.0	2.71	2.89	2.93	2.89	2.84	2.80	2.76	2.71	2.67	2.62	2.58	2.54
55.5	2.75	2.93	2.98	2.94	2.89	2.85	2.80	2.76	2.72	2.67	2.63	2.58
56.0	2.79	2.97	3.03	2.98	2.94	2.89	2.85	2.81	2.76	2.72	2.67	2.63
56.5	2.83	3.01	3.07	3.03	2.99	2.94	2.90	2.85	2.81	2.77	2.72	2.68
57.0	2.87	3.06	3.12	3.08	3.03	2.99	2.94	2.90	2.86	2.81	2.77	2.72
57.5	2.91	3.10	3.17	3.12	3.08	3.04	2.99	2.95	2.90	2.86	2.82	2.77
58.0	2.96	3.14	3.21	3.17	3.13	3.08	3.04	2.99	2.95	2.91	2.86	2.82
58.5	3.00	3.18	3.26	3.22	3.17	3.13	3.09	3.04	3.00	2.95	2.91	2.87
59.0	3.04	3.22	3.31	3.26	3.22	3.18	3.13	3.09	3.04	3.00	2.96	2.91
59.5	3.08	3.27	3.36	3.31	3.27	3.22	3.18	3.14	3.09	3.05	3.00	2.96
60.0	3.12	3.31	3.40	3.36	3.31	3.27	3.23	3.18	3.14	3.09	3.05	3.01
60.5	3.17	3.35	3.45	3.41	3.36	3.32	3.27	3.23	3.19	3.14	3.10	3.05
61.0	3.21	3.39	3.50	3.45	3.41	3.36	3.32	3.28	3.23	3.19	3.14	3.10
61.5	3.25	3.43	3.54	3.50	3.46	3.41	3.37	3.32	3.28	3.24	3.19	3.15
62.0	3.29	3.48	3.59	3.55	3.50	3.46	3.41	3.37	3.33	3.28	3.24	3.19
62.5	3.33	3.52	3.64	3.59	3.55	3.51	3.46	3.42	3.37	3.33	3.29	3.24
63.0	3.38	3.56	3.68	3.64	3.60	3.55	3.51	3.46	3.42	3.38	3.33	3.29
63.5	3.42	3.60	3.73	3.69	3.64	3.60	3.56	3.51	3.47	3.42	3.38	3.34
64.0	3.46	3.64	3.78	3.73	3.69	3.65	3.60	3.56	3.51	3.47	3.43	3.38
64.5	3.50	3.69	3.83	3.78	3.74	3.69	3.65	3.61	3.56	3.52	3.47	3.43
65.0	3.54	3.73	3.87	3.83	3.78	3.74	3.70	3.65	3.61	3.56	3.52	3.48
65.5	3.59	3.77	3.92	3.88	3.83	3.79	3.74	3.70	3.66	3.61	3.57	3.52
66.0	3.63	3.81	3.97	3.92	3.88	3.83	3.79	3.75	3.70	3.66	3.61	3.57
66.5	3.67	3.85	4.01	3.97	3.93	3.88	3.84	3.79	3.75	3.71	3.66	3.62
67.0	3.71	3.89	4.06	4.02	3.97	3.93	3.88	3.84	3.80	3.75	3.71	3.66
67.5	3.75	3.94	4.11	4.06	4.02	3.98	3.93	3.89	3.84	3.80	3.76	3.71
68.0	3.79	3.98	4.15	4.11	4.07	4.02	3.98	3.93	3.89	3.85	3.80	3.76
68.5	3.84	4.02	4.20	4.16	4.11	4.07	4.03	3.98	3.94	3.89	3.85	3.81
69.0	3.88	4.06	4.25	4.20	4.16	4.12	4.07	4.03	3.98	3.94	3.90	3.85
69.5	3.92	4.10	4.30	4.29	4.21	4.16	4.12	4.08	4.03	3.99	3.94	3.90
70.0	3.96	4.15	4.34	4.30	4.25	4.21	4.17	4.12	4.08	4.03	3.99	3.95
70.5	4.00	4.19	4.39	4.35	4.30	4.26	4.21	4.17	4.13	4.08	4.04	3.99
71.0	4.05	4.23	4.44	4.39	4.35	4.30	4.26	4.22	4.17	4.13	4.08	4.04
71.5	4.09	4.27	4.48	4.44	4.40	4.35	4.31	4.26	4.22	4.18	4.13	4.09
72.0	4.13	4.31	4.53	4.49	4.44	4.40	4.35	4.31	4.27	4.22	4.18	4.13
72.5	4.17	4.36	4.58	4.53	4.49	4.45	4.40	4.36	4.31	4.27	4.23	4.18
73.0	4.21	4.40	4.62	4.58	4.54	4.49	4.45	4.40	4.36	4.32	4.27	4.23
73.5	4.26	4.44	4.67	4.63	4.50	4.54	4.50	4.45	4.41	4.36	4.32	4.28
74.0	4.30	4.48	4.72	4.67	4.63	4.59	4.54	4.50	4.45	4.41	4.37	4.32
74.5	4.34	4.52	4.77	4.72	4.68	4.63	4.59	4.55	4.50	4.46	4.41	4.37
75.0	4.38	4.57	4.81	4.77	4.72	4.68	4.64	4.59	4.55	4.50	4.46	4.42
75.5	4.42	4.61	4.86	4.82	4.77	4.73	4.68	4.64	4.60	4.55	4.51	4.46
76.0	4.47	4.65	4.91	4.86	4.82	4.77	4.73	4.69	4.64	4.60	4.55	4.51
76.5	4.51	4.69	4.95	4.91	4.87	4.82	4.78	4.73	4.69	4.65	4.60	4.56
77.0	4.55	4.73	5.00	4.96	4.91	4.87	4.82	4.78	4.74	4.69	4.65	4.60

WAC 296-62-14539 Table 3 (Cont.)

	AGE												
HT	41	43	45	47	49	51	53	55	57	59	61	63	65
52.0	2.21	2.17	2.12	2.08	2.03	1.99	1.95	1.90	1.86	1.81	1.77	1.73	1.68
52.5	2.26	2.21	2.17	2.13	2.08	2.04	1.99	1.95	1.91	1.86	1.82	1.77	1.73
53.0	2.30	2.26	2.22	2.17	2.13	2.08	2.04	2.00	1.95	1.91	1.86	1.82	1.78
53.5	2.35	2.31	2.26	2.22	2.18	2.13	2.09	2.04	2.00	1.96	1.91	1.87	1.82
54.0	2.40	2.35	2.31	2.27	2.22	2.18	2.13	2.09	2.05	2.00	1.96	1.91	1.87
54.5	2.45	2.40	2.36	2.31	2.27	2.23	2.18	2.14	2.09	2.05	2.01	1.96	1.92
55.0	2.49	2.45	2.40	2.36	2.32	2.27	2.23	2.18	2.14	2.10	2.05	2.01	1.96
55.5	2.54	2.50	2.45	2.41	2.36	2.32	2.28	2.23	2.19	2.14	2.10	2.06	2.01
56.0	2.59	2.54	2.50	2.45	2.41	2.37	2.32	2.28	2.23	2.19	2.15	2.10	2.06
56.5	2.63	2.59	2.55	2.50	2.46	2.41	2.37	2.33	2.28	2.24	2.19	2.15	2.11
57.0	2.68	2.64	2.59	2.55	2.50	2.46	2.42	2.37	2.33	2.28	2.24	2.20	2.15
57.5	2.73	2.68	2.64	2.60	2.55	2.51	2.46	2.42	2.38	2.33	2.29	2.24	2.20
58.0	2.77	2.73	2.69	2.64	2.60	2.55	2.51	2.47	2.42	2.38	2.33	2.29	2.25
58.5	2.82	2.78	2.73	2.69	2.65	2.60	2.56	2.51	2.47	2.43	2.38	2.34	2.29
59.0	2.87	2.82	2.78	2.74	2.69	2.65	2.60	2.56	2.52	2.47	2.43	2.38	2.34
59.5	2.92	2.87	2.83	2.78	2.74	2.70	2.65	2.61	2.56	2.52	2.48	2.43	2.39
60.0	2.96	2.92	2.87	2.83	2.79	2.74	2.70	2.65	2.61	2.57	2.52	2.48	2.43
60.5	3.01	2.97	2.92	2.88	2.83	2.79	2.75	2.70	2.66	2.61	2.57	2.53	2.48
61.0	3.06	3.01	2.97	2.92	2.88	2.84	2.79	2.75	2.70	2.66	2.62	2.57	2.53
61.5	3.10	3.06	3.02	2.97	2.93	2.88	2.84	2.80	2.75	2.71	2.66	2.62	2.58
62.0	3.15	3.11	3.06	3.02	2.97	2.93	2.89	2.84	2.80	2.75	2.71	2.67	2.62
62.5	3.20	3.15	3.11	3.07	3.02	2.98	2.93	2.89	2.85	2.80	2.76	2.71	2.67
63.0	3.24	3.20	3.16	3.11	3.07	3.02	2.98	2.94	2.89	2.85	2.80	2.76	2.72
63.5	3.29	3.25	3.20	3.16	3.12	3.07	3.03	2.98	2.94	2.90	2.85	2.81	2.76
64.0	3.34	3.29	3.25	3.21	3.16	3.12	3.07	3.03	2.99	2.94	2.90	2.85	2.81
64.5	3.39	3.34	3.30	3.25	3.21	3.17	3.12	3.08	3.03	2.99	2.95	2.90	2.86
65.0	3.43	3.39	3.34	3.30	3.26	3.21	3.17	3.12	3.08	3.04	2.99	2.95	2.90
65.5	3.48	3.44	3.39	3.35	3.30	3.26	3.22	3.17	3.13	3.08	3.04	3.00	2.95
66.0	3.53	3.48	3.44	3.39	3.35	3.31	3.26	3.22	3.17	3.13	3.09	3.04	3.00
66.5	3.57	3.53	3.49	3.44	3.40	3.35	3.31	3.27	3.22	3.18	3.13	3.09	3.05
67.0	3.62	3.58	3.53	3.49	3.44	3.40	3.36	3.31	3.27	3.22	3.18	3.14	3.09
67.5	3.67	3.62	3.58	3.54	3.49	3.45	3.40	3.36	3.32	3.27	3.23	3.18	3.14
68.0	3.71	3.67	3.63	3.58	3.54	3.49	3.45	3.41	3.36	3.32	3.27	3.23	3.19
68.5	3.76	3.72	3.67	3.63	3.59	3.54	3.50	3.45	3.41	3.37	3.32	3.28	3.23
69.0	3.81	3.76	3.72	3.68	3.63	3.59	3.54	3.50	3.46	3.41	3.37	3.32	3.28
69.5	3.86	3.81	3.77	3.72	3.68	3.64	3.59	3.55	3.50	3.46	3.42	3.37	3.33
70.0	3.90	3.86	3.81	3.77	3.73	3.68	3.64	3.59	3.55	3.51	3.46	3.42	3.37
70.5	3.95	3.91	3.86	3.82	3.77	3.73	3.69	3.64	3.60	3.55	3.51	3.47	3.42
71.0	4.00	3.95	3.91	3.86	3.82	3.78	3.73	3.69	3.64	3.60	3.56	3.51	3.47
71.5	4.04	4.00	3.96	3.91	3.87	3.82	3.78	3.74	3.69	3.65	3.60	3.56	3.52
72.0	4.09	4.05	4.00	3.96	3.91	3.87	3.83	3.78	3.74	3.69	3.65	3.61	3.56
72.5	4.14	4.09	4.05	4.01	3.96	3.92	3.87	3.83	3.79	3.74	3.70	3.65	3.61
73.0	4.18	4.14	4.10	4.05	4.01	3.96	3.92	3.88	3.83	3.79	3.74	3.70	3.66
73.5	4.23	4.19	4.14	4.10	4.06	4.01	3.97	3.92	3.88	3.84	3.79	3.75	3.70
74.0	4.28	4.23	4.19	4.15	4.10	4.06	4.01	3.97	3.93	3.88	3.84	3.79	3.75
74.5	4.33	4.28	4.24	4.19	4.15	4.11	4.06	4.02	3.97	3.93	3.89	3.84	3.80
75.0	4.37	4.33	4.28	4.24	4.20	4.15	4.11	4.06	4.02	3.98	3.93	3.89	3.84
75.5	4.42	4.38	4.33	4.29	4.24	4.20	4.16	4.11	4.07	4.02	3.98	3.94	3.89
76.0	4.47	4.42	4.38	4.33	4.29	4.25	4.20	4.16	4.11	4.07	4.03	3.98	3.94
76.5	4.51	4.47	4.43	4.38	4.34	4.29	4.25	4.21	4.16	4.12	4.07	4.03	3.99
77.0	4.56	4.52	4.47	4.43	4.38	4.34	4.30	4.25	4.21	4.16	4.12	4.08	4.03

WAC 296-62-14539 (Cont.)

TABLE 4. PREDICTED FEV (1) FOR FEMALES (KNUDSON,ETAL.:AM. REV. RESPIR.DIS.1976,113,587.)

	AGE											
HT	17	19	21	23	25	27	29	31	33	35	37	39
52.0	2.31	2.48	2.33	2.29	2.25	2.21	2.16	2.12	2.08	2.04	2.00	1.95
52.5	2.34	2.51	2.37	2.32	2.28	2.24	2.20	2.16	2.11	2.07	2.03	1.99
53.0	2.38	2.55	2.40	2.36	2.32	2.27	2.23	2.19	2.15	2.11	2.06	2.02
53.5	2.41	2.58	2.43	2.39	2.35	2.31	2.27	2.22	2.18	2.14	2.10	2.06
54.0	2.45	2.62	2.47	2.43	2.38	2.34	2.30	2.26	2.22	2.17	2.13	2.09
54.5	2.48	2.65	2.50	2.46	2.42	2.38	2.33	2.29	2.25	2.21	2.17	2.12
55.0	2.51	2.68	2.54	2.49	2.45	2.41	2.37	2.33	2.28	2.24	2.20	2.16
55.5	2.55	2.72	2.57	2.53	2.49	2.45	2.40	2.36	2.32	2.28	2.24	2.19
56.0	2.58	2.75	2.61	2.56	2.52	2.48	2.44	2.40	2.35	2.31	2.27	2.23
56.5	2.62	2.79	2.64	2.60	2.56	2.51	2.47	2.43	2.39	2.35	2.30	2.26
57.0	2.65	2.82	2.67	2.63	2.59	2.55	2.51	2.46	2.42	2.38	2.34	2.30
57.5	2.69	2.86	2.71	2.67	2.62	2.58	2.54	2.50	2.46	2.41	2.37	2.33
58.0	2.72	2.89	2.74	2.70	2.66	2.62	2.57	2.53	2.49	2.45	2.41	2.36
58.5	2.75	2.92	2.78	2.73	2.69	2.65	2.61	2.57	2.52	2.48	2.44	2.40
59.0	2.79	2.96	2.81	2.77	2.73	2.69	2.64	2.60	2.56	2.52	2.48	2.43
59.5	2.82	2.99	2.85	2.80	2.76	2.72	2.68	2.64	2.59	2.55	2.51	2.47
60.0	2.86	3.03	2.88	2.84	2.80	2.75	2.71	2.67	2.63	2.59	2.54	2.50
60.5	2.89	3.06	2.91	2.87	2.83	2.79	2.75	2.70	2.66	2.62	2.58	2.54
61.0	2.93	3.10	2.95	2.91	2.86	2.82	2.78	2.74	2.70	2.65	2.61	2.57
61.5	2.96	3.13	2.98	2.94	2.90	2.86	2.81	2.77	2.73	2.69	2.65	2.60
62.0	2.99	3.16	3.02	2.97	2.93	2.89	2.85	2.81	2.76	2.72	2.68	2.64
62.5	3.03	3.20	3.05	3.01	2.97	2.93	2.88	2.84	2.80	2.76	2.72	2.67
63.0	3.06	3.23	3.09	3.04	3.00	2.96	2.92	2.88	2.83	2.79	2.75	2.71
63.5	3.10	3.27	3.12	3.08	3.04	2.99	2.95	2.91	2.87	2.83	2.78	2.74
64.0	3.13	3.30	3.15	3.11	3.07	3.03	2.99	2.94	2.90	2.86	2.82	2.78
64.5	3.17	3.34	3.19	3.15	3.10	3.06	3.02	2.98	2.94	2.89	2.85	2.81
65.0	3.20	3.37	3.22	3.18	3.14	3.10	3.05	3.01	2.97	2.93	2.89	2.84
65.5	3.23	3.40	3.26	3.21	3.17	3.13	3.09	3.05	3.00	2.96	2.92	2.88
66.0	3.27	3.44	3.29	3.25	3.21	3.17	3.12	3.08	3.04	3.00	2.96	2.91
66.5	3.30	3.47	3.33	3.28	3.24	3.20	3.16	3.12	3.07	3.03	2.99	2.95
67.0	3.34	3.51	3.36	3.32	3.28	3.23	3.19	3.15	3.11	3.07	3.02	2.98
67.5	3.37	3.54	3.39	3.35	3.31	3.27	3.23	3.18	3.14	3.10	3.06	3.02
68.0	3.41	3.58	3.43	3.39	3.34	3.30	3.26	3.22	3.18	3.13	3.09	3.05
68.5	3.44	3.61	3.46	3.42	3.38	3.34	3.29	3.25	3.21	3.17	3.13	3.08
69.0	3.47	3.64	3.50	3.46	3.41	3.37	3.33	3.29	3.25	3.20	3.16	3.12
69.5	3.51	3.68	3.53	3.49	3.45	3.41	3.36	3.32	3.28	3.24	3.20	3.15
70.0	3.54	3.71	3.57	3.52	3.48	3.44	3.40	3.36	3.31	3.27	3.23	3.19
70.5	3.58	3.75	3.60	3.56	3.52	3.47	3.43	3.39	3.35	3.31	3.26	3.22
71.0	3.61	3.78	3.63	3.59	3.55	3.51	3.47	3.42	3.38	3.34	3.30	3.26
71.5	3.65	3.82	3.67	3.63	3.58	3.54	3.50	3.46	3.42	3.37	3.33	3.29
72.0	3.68	3.85	3.70	3.66	3.62	3.58	3.53	3.49	3.45	3.41	3.37	3.32
72.5	3.71	3.88	3.74	3.70	3.65	3.61	3.57	3.53	3.49	3.44	3.40	3.36
73.0	3.75	3.92	3.77	3.73	3.69	3.65	3.60	3.56	3.52	3.48	3.44	3.39
73.5	3.78	3.95	3.81	3.76	3.72	3.68	3.64	3.60	3.55	3.51	3.47	3.43
74.0	3.82	3.99	3.84	3.80	3.76	3.71	3.67	3.63	3.59	3.55	3.50	3.46
74.5	3.85	4.02	3.87	3.83	3.79	3.75	3.71	3.66	3.62	3.58	3.54	3.50
75.0	3.89	4.06	3.91	3.87	3.82	3.78	3.74	3.70	3.66	3.61	3.57	3.53
75.5	3.92	4.09	3.94	3.90	3.86	3.82	3.77	3.73	3.69	3.65	3.61	3.56
76.0	3.95	4.12	3.98	3.94	3.89	3.85	3.81	3.77	3.73	3.68	3.64	3.60
76.5	3.99	4.16	4.01	3.97	3.93	3.89	3.84	3.80	3.76	3.72	3.68	3.63
77.0	4.02	4.19	4.05	4.00	3.96	3.92	3.88	3.84	3.79	3.75	3.71	3.67

WAC 296-62-14539 Table 4 (Cont.)

	AGE												
HT	41	43	45	47	49	51	53	55	57	59	61	63	65
52.0	1.91	1.87	1.83	1.79	1.74	1.70	1.66	1.62	1.58	1.53	1.49	1.45	1.41
52.5	1.95	1.90	1.86	1.82	1.78	1.74	1.69	1.65	1.61	1.57	1.53	1.48	1.44
53.0	1.98	1.94	1.90	1.85	1.81	1.77	1.73	1.69	1.64	1.60	1.56	1.52	1.48
53.5	2.01	1.97	1.93	1.89	1.85	1.80	1.76	1.72	1.68	1.64	1.59	1.55	1.51
54.0	2.05	2.01	1.96	1.92	1.88	1.84	1.80	1.75	1.71	1.67	1.63	1.59	1.54
54.5	2.08	2.04	2.00	1.96	1.91	1.87	1.83	1.79	1.75	1.70	1.66	1.62	1.58
55.0	2.12	2.07	2.03	1.99	1.95	1.91	1.86	1.82	1.78	1.74	1.70	1.65	1.61
55.5	2.15	2.11	2.07	2.03	1.98	1.94	1.90	1.86	1.82	1.77	1.73	1.69	1.65
56.0	2.19	2.14	2.10	2.06	2.02	1.98	1.93	1.89	1.85	1.81	1.77	1.72	1.68
56.5	2.22	2.18	2.14	2.09	2.05	2.01	1.97	1.93	1.88	1.84	1.80	1.76	1.72
57.0	2.25	2.21	2.17	2.13	2.09	2.04	2.00	1.96	1.92	1.88	1.83	1.79	1.75
57.5	2.29	2.25	2.20	2.16	2.12	2.08	2.04	1.99	1.95	1.91	1.87	1.83	1.78
58.0	2.32	2.28	2.24	2.20	2.15	2.11	2.07	2.03	1.99	1.94	1.90	1.86	1.82
58.5	2.36	2.31	2.27	2.23	2.19	2.15	2.10	2.06	2.02	1.98	1.94	1.89	1.85
59.0	2.39	2.35	2.31	2.27	2.22	2.18	2.14	2.10	2.06	2.01	1.97	1.93	1.89
59.5	2.43	2.38	2.34	2.30	2.26	2.22	2.17	2.13	2.09	2.05	2.01	1.96	1.92
60.0	2.46	2.42	2.38	2.33	2.29	2.25	2.21	2.17	2.12	2.08	2.04	2.00	1.96
60.5	2.49	2.45	2.41	2.37	2.33	2.28	2.24	2.20	2.16	2.12	2.07	2.03	1.99
61.0	2.53	2.49	2.44	2.40	2.36	2.32	2.28	2.23	2.19	2.15	2.11	2.07	2.02
61.5	2.56	2.52	2.48	2.44	2.39	2.35	2.31	2.27	2.23	2.18	2.14	2.10	2.06
62.0	2.60	2.55	2.51	2.47	2.43	2.39	2.34	2.30	2.26	2.22	2.18	2.13	2.09
62.5	2.63	2.59	2.55	2.51	2.46	2.42	2.38	2.34	2.30	2.25	2.21	2.17	2.13
63.0	2.67	2.62	2.58	2.54	2.50	2.46	2.41	2.37	2.33	2.29	2.25	2.20	2.16
63.5	2.70	2.66	2.62	2.57	2.53	2.49	2.45	2.41	2.36	2.32	2.28	2.24	2.20
64.0	2.73	2.69	2.65	2.61	2.57	2.52	2.48	2.44	2.40	2.36	2.31	2.27	2.23
64.5	2.77	2.73	2.68	2.64	2.60	2.56	2.52	2.47	2.43	2.39	2.35	2.31	2.26
65.0	2.80	2.76	2.72	2.68	2.63	2.59	2.55	2.51	2.47	2.42	2.38	2.34	2.30
65.5	2.84	2.79	2.75	2.71	2.67	2.63	2.58	2.54	2.50	2.46	2.42	2.37	2.33
66.0	2.87	2.83	2.79	2.75	2.70	2.66	2.62	2.58	2.54	2.49	2.45	2.41	2.37
66.5	2.91	2.86	2.82	2.78	2.74	2.70	2.65	2.61	2.57	2.53	2.49	2.44	2.40
67.0	2.94	2.90	2.86	2.81	2.77	2.73	2.69	2.65	2.60	2.56	2.52	2.48	2.44
67.5	2.97	2.94	2.89	2.85	2.81	2.76	2.72	2.68	2.64	2.60	2.55	2.51	2.47
68.0	3.01	2.97	2.92	2.88	2.84	2.80	2.76	2.71	2.67	2.63	2.59	2.55	2.50
68.5	3.04	3.00	2.96	2.92	2.87	2.83	2.79	2.75	2.71	2.66	2.62	2.58	2.54
69.0	3.08	3.04	2.99	2.95	2.91	2.87	2.83	2.78	2.74	2.70	2.66	2.62	2.57
69.5	3.11	3.07	3.03	2.99	2.94	2.90	2.86	2.82	2.78	2.73	2.69	2.65	2.61
70.0	3.15	3.10	3.06	3.02	2.98	2.94	2.89	2.85	2.81	2.77	2.73	2.68	2.64
70.5	3.18	3.14	3.10	3.05	3.01	2.97	2.93	2.89	2.84	2.80	2.76	2.72	2.68
71.0	3.21	3.17	3.13	3.09	3.05	3.00	2.96	2.92	2.88	2.84	2.79	2.75	2.71
71.5	3.25	3.21	3.16	3.12	3.08	3.04	3.00	2.95	2.91	2.87	2.83	2.79	2.74
72.0	3.28	3.24	3.20	3.16	3.11	3.07	3.03	2.99	2.95	2.90	2.86	2.82	2.78
72.5	3.32	3.28	3.23	3.19	3.15	3.11	3.07	3.02	2.98	2.94	2.90	2.86	2.81
73.0	3.35	3.31	3.27	3.23	3.18	3.14	3.10	3.06	3.02	2.97	2.93	2.89	2.85
73.5	3.39	3.34	3.30	3.26	3.22	3.18	3.13	3.09	3.05	3.01	2.97	2.92	2.88
74.0	3.42	3.38	3.34	3.29	3.25	3.21	3.17	3.13	3.08	3.04	3.00	2.96	2.92
74.5	3.45	3.41	3.37	3.33	3.29	3.24	3.20	3.16	3.12	3.08	3.03	2.99	2.95
75.0	3.49	3.45	3.40	3.36	3.32	3.28	3.24	3.19	3.15	3.11	3.07	3.03	2.98
75.5	3.52	3.48	3.44	3.40	3.35	3.31	3.27	3.23	3.19	3.14	3.10	3.06	3.02
76.0	3.56	3.52	3.47	3.43	3.39	3.35	3.31	3.26	3.22	3.18	3.14	3.10	3.05
76.5	3.59	3.55	3.51	3.47	3.42	3.38	3.34	3.30	3.26	3.21	3.17	3.13	3.09
77.0	3.63	3.58	3.54	3.50	3.46	3.42	3.37	3.33	3.29	3.25	3.21	3.16	3.12

[Statutory Authority: Chapter 49.17 RCW. 87-24-051 (Order 87-24), 296-62-14539, filed 11/30/87.]

WAC 296-62-14541 Appendix D--Pulmonary function standards for cotton dust standard. The spirometric measurements of pulmonary function shall conform to the following minimum standards, and these standards are not intended to preclude additional testing or alternate methods which can be determined to be superior.

(1) **Apparatus**

(a) The instrument shall be accurate to within ±50 milliliters or within ±3 percent of reading, whichever is greater.

(b) The instrument should be capable of measuring vital capacity from 0 to 7 liters BTPS.

(c) The instrument shall have a low inertia and offer low resistance to airflow such that the resistance to airflow at 12 liters per second must be less than 1.5 cm. H_2O/liter/sec.

(d) The zero time point for the purpose of timing the FEV_1 shall be determined by extrapolating the steepest portion of the volume time curve back to the maximal inspiration volume (1, 2, 3, 4) or by an equivalent method.

(e) Instruments incorporating measurements of airflow to determine volume shall conform to the same volume accuracy stated in (a) of this subsection when presented with flow rates from at least 0 to 12 liters per second.

(f) The instrument or user of the instrument must have means of correcting volumes to a body temperature saturated with water vapor (BTPS) under conditions of varying ambient spirometer temperatures and barometric pressures.

(g) The instrument used shall provide a tracing or display of either flow versus volume or volume versus time during the entire forced expiration. A tracing or display is necessary to determine whether the patient has performed the test properly. The tracing must be stored and available for recall and must be of sufficient size that hand measurements may be made within requirement of (a) of this subsection. If a paper record is made it must have a paper speed of at least 2 cm/sec and a volume sensitivity of at least 10.0 mm of chart per liter of volume.

(h) The instrument shall be capable of accumulating volume for a minimum of ten seconds and shall not stop accumulating volume before (i) the volume change for a 0.5 second interval is less than 25 milliliters or (ii) the flow is less than 50 milliliters per second for a 0.5 second interval.

(i) The forced vital capacity (FVC) and forced expiratory volume in l second $FEV_{1.0}$ measurements shall comply with the accuracy requirements stated in (a) of this subsection. That is, they should be accurately measured to within ± 50 ml or within ±3 percent of reading, whichever is greater.

(j) The instrument must be capable of being calibrated in the field with respect to the FEV_1 and FVC. This calibration of the FEV_1 and FVC may be either directly or indirectly through volume and time base measurements. The volume calibration source should provide a volume displacement of at least 2 liters and should be accurate to within ±30 milliliters.

(2) **Technique for measurement of forced vital capacity maneuver.**

(a) Use of a nose clip is recommended but not required. The procedures shall be explained in simple terms to the patient who shall be instructed to loosen any tight clothing and stand in front of the apparatus. The subject may sit, but care should be taken on repeat testing that same position be used and, if possible, the same spirometer. Particular attention shall be given to insure that the chin is slightly elevated with the neck slightly extended. The patient shall be instructed to make a full inspiration from a normal breathing pattern and then blow into the apparatus, without interruption, as hard, fast, and completely as possible. At least three forced expirations shall be

carried out. During the maneuvers, the patient shall be observed for compliance with instructions. The expirations shall be checked visually for reproducibility from flow-volume or volume-time tracings or displays. The following efforts shall be judged unacceptable when the patient:

(i) Has not reached full inspiration preceding the forced expiration,

(ii) Has not used maximal effort during the entire forced expiration,

(iii) Has not continued the expiration for at least 5 seconds or until an obvious plateau in the volume time curve has occurred,

(iv) Has coughed or closed his glottis,

(v) Has an obstructed mouthpiece or a leak around the mouthpiece (obstruction due to tongue being placed in front of mouthpiece, false teeth falling in front of mouthpiece, etc.),

(vi) Has an unsatisfactory start of expiration, one characterized by excessive hesitation (or false starts), and therefore not allowing back extrapolation of time 0 (extrapolated volume on the volume time tracing must be less than 10 percent of the FVC),

(vii) Has an excessive variability between the three acceptable curves. The variation between the two largest FVC's and $FEV_{1's}$ of the three satisfactory tracings should not exceed 10 percent or ±100 milliliters, whichever is greater.

(b) Periodic and routine recalibration of the instrument or method for recording FVC and $FEV_{1.0}$ should be performed using a syringe or other volume source of at least 2 liters.

(3) **Interpretation of spirogram.**

(a) The first step in evaluating a spirogram should be to determine whether or not the patient has performed the test properly or as described in subsection (2) of this section. From the three satisfactory tracings, the forced vital capacity (FVC) and forced expiratory volume in 1 second ($FEV_{1.0}$) shall be measured and recorded. The largest observed FVC and largest observed $FEV_{1.0}$ shall be used in the analysis regardless of the curve(s) on which they occur.

(b) The following guidelines are recommended by NIOSH for the evaluation and management of workers exposed to cotton dust. It is important to note that employees who show reductions in FEV_1/FVC ratio below .75 or drops in Monday FEV_1 of 5 percent or greater on their initial screening exam, should be reevaluated within a month of the first exam. Those who show consistent decrease in lung function, as shown on the following table, should be managed as recommended.

(4) **Qualifications of personnel administering the test.**

Technicians who perform pulmonary function testing should have the basic knowledge required to produce meaningful results. Training consisting of approximately 16 hours of formal instruction should cover the following areas.

(a) Basic physiology of the forced vital capacity maneuver and the determinants of airflow limitation with emphasis on the relation to reproducibility of results.

(b) Instrumentation requirements including calibration procedures, sources of error and their correction.

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(c) Performance of the testing including subject coaching, recognition of improperly performed maneuvers and corrective actions.

(d) Data quality with emphasis on reproducibility.

(e) Actual use of the equipment under supervised conditions.

(f) Measurement of tracings and calculations of results.

[Statutory Authority: Chapter 49.17 RCW. 88-14-108 (Order 88-11), 296-62-14541, filed 7/6/88; 87-24-051 (Order 87-24), 296-62-14541, filed 11/30/87.]

WAC 296-62-14543 Appendix E--Vertical elutriator equivalency protocol.

(a) Samples to be taken--In order to ascertain equivalency, it is necessary to collect a total of 100 samples from at least 10 sites in a mill. That is, there should be 10 replicate readings at each of 10 sites. The sites should represent dust levels which vary over the allowable range of 0.5 to 2 times the permissible exposure limit. Each sample requires the use of two vertical elutriators (VE's) and at least one but not more than two alternative devices (AD's). Thus, the end result is 200 VE readings and either 100 or 200 AD readings. The 2 VE readings and the 1 or 2 AD readings at each time and site must be made simultaneously. That is, the two VE's and one or two AD's must be arranged together in such a way that they are measuring essentially the same dust levels.

(b) Data averaging--The two VE readings taken at each site are then averaged. These averages are to be used as the 100 VE readings. If two alternate devices were used, their test results are also averaged. Thus, after this step is accomplished, there will be 100 VE readings and 100 AD readings.

(c) Differences--For each of the 100 sets of measurements (VE and AD) the difference is obtained as the average VE reading minus the AD reading. Call these differences Di. Thus, we have.

$$\mathbf{Di = VEi - ADi,\ i = 1,2, \ldots ,100} \quad \mathbf{(1)}$$

Next we compute the arithmetic mean and standard deviations of the differences, using equations (2) and (3), respectively.

$$S_D = \sqrt{\frac{\sum D_i^2 - \frac{\left(\sum D_i\right)^2}{N}}{}} \quad \mathbf{(3)}$$

where N equals the number of differences (100 in this case).
$\overline{X}_D$ is the arithmetic mean and S_D is the standard deviation.

We next calculate the critical value as $T = KS_D + \left|\overline{X}_D\right|$
where X = 1.87, based on 100 samples.

$$\overline{X}_D = \frac{1}{N}\sum_{i=1}^{N} D_i \quad \mathbf{(2)}$$

(d) Equivalency test. The next step is to obtain the average of the 100 VE readings. This is obtained by equation (4)

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$$X_{VE} = \frac{1}{N}\left(\sum_{i=1}^{N} VE_i\right) \quad (4)$$

We next multiply 0.25 by $\overline{X}_{VE}$. If $T < 0.25\,\overline{X}_{VE}$, we can say that the alternate device has passed the equivalency test.

[Statutory Authority: RCW 49.17.040 and 49.17.050. 86-16-009 (Order 86-28), 296-62-14543, filed 7/25/86.]

PART O
COKE OVENS

WAC

WAC 296-62-200 Coke oven emissions. Scope and application. This section applies to the control of employee exposure to coke oven emissions.
[Order 77-14, 296-62-200, filed 7/25/77.]

WAC 296-62-20001 Definitions. For the purpose of this section:

(1) **"Authorized person."** Any person specifically authorized by the employer whose duties require the person to enter a regulated area, or any person entering such an area as a designated representative of employees for the purpose of exercising the opportunity to observe monitoring and measuring procedures under WAC 296-62-20025.

(2) **"Beehive oven."** A coke oven in which the products of carbonization other than coke are not recovered, but are released into the ambient air.

(3) **"Coke oven."** A retort in which coke is produced by the destructive distillation or carbonization of coal.

(4) **"Coke oven battery."** A structure containing a number of slot-type coke ovens.

(5) **"Coke oven emissions."** The benzenesoluble fraction of total particulate matter present during the destructive distillation or carbonization of coal for the production of coke.

(6) **"Director."** The director of the department of labor and industries or his or her authorized representative.

(7) **"Emergency."** Any occurrence such as, but not limited to, equipment failure which is likely to, or does, result in any massive release of coke oven emissions.

(8) **"Existing coke oven battery."** A battery in operation or under construction on January 20, 1977, and which is not rehabilitated.

(9) **"Rehabilitated coke oven battery."** A battery which is rebuilt, overhauled, renovated, or restored such as from the pad up, after January 20, 1977.

(10) **"Stage charging."** A procedure by which a predetermined volume of coal in each larry car hopper is introduced into an oven such that no more than two hoppers are discharging simultaneously.

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(11) **"Sequential charging."** A procedure, usually automatically timed, by which a predetermined volume of coal in each larry car hopper is introduced into an oven such that no more than two hoppers commence or finish discharging simultaneously although, at some point, all hoppers are discharging simultaneously.

(12) **"Pipeline charging."** Any apparatus used to introduce coal into an oven which uses a pipe or duct permanently mounted onto an oven and through which coal is charged.

(13) **"Green push."** Coke which when removed from the oven results in emissions due to the presence of unvolatized coal.

[Order 77-14, 296-62-20001, filed 7/25/77.]

WAC 296-62-20003 Permissible exposure limit. The employer shall assure that no employee is exposed to coke oven emissions at concentrations greater than 150 micrograms per cubic meter of air (150 $\mu g/m^3$), averaged over any 8-hour period.

[Order 77-14, 296-62-20003, filed 7/25/77.]

WAC 296-62-20005 Regulated areas.

(1) The employer shall establish regulated areas and shall limit access to them to authorized persons.

(2) The employer shall establish the following as regulated areas:

(a) The coke oven battery including topside and its machinery, pushside and its machinery, coke side and its machinery, and the battery ends; the wharf; and the screening station;

(b) The beehive oven and its machinery.

[Order 77-14, 296-62-20005, filed 7/25/77.]

WAC 296-62-20007 Exposure monitoring and measurement.

(1) **Monitoring program.**

(a) Each employer who has a place of employment where coke oven emissions are present shall monitor employees employed in the regulated area to measure their exposure to coke oven emissions.

(b) The employer shall obtain measurements which are representative of each employee's exposure to coke oven emissions over an eight-hour period. All measurements shall determine exposure without regard to the use of respiratory protection.

(c) The employer shall collect full-shift (for at least seven continuous hours) personal samples, including at least one sample during each shift for each battery and each job classification within the regulated areas including at least the following job classifications:

(i) Lidman;

(ii) Tar chaser;

(iii) Larry car operator;

(iv) Luterman;

(v) Machine operator, coke side;

(vi) Benchman, coke side;

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(vii) Benchman, pusher side;

(viii) Heater;

(ix) Quenching car operator;

(x) Pusher machine operator;

(xi) Screening station operator;

(xii) Wharfman;

(xiii) Oven patcher;

(xiv) Oven repairman;

(xv) Spellman; and

(xvi) Maintenance personnel.

(d) The employer shall repeat the monitoring and measurements required by subsection (1) of this section at least every three months.

(2) **Redetermination.** Whenever there has been a production, process, or control change which may result in new or additional exposure to coke oven emissions, or whenever the employer has any other reason to suspect an increase in employee exposure, the employer shall repeat the monitoring and measurements required by subsection (1) of this section for those employees affected by such change or increase.

(3) **Employee notification.**

(a) The employer shall notify each employee in writing of the exposure measurements which represent that employee's exposure within five working days after the receipt of the results of measurements required by subsection (1) and (2) of this section.

(b) Whenever such results indicate that the representative employee exposure exceeds the permissible exposure limit, the employer shall, in such notification, inform each employee of that fact and of the corrective action being taken to reduce exposure to or below the permissible exposure limit.

(4) **Accuracy of measurement.** The employer shall use a method of monitoring and measurement which has an accuracy (with a confidence level of 95%) of not less than plus or minus 35% for concentrations of coke oven emissions greater than or equal to 150 Ug/m^3.

[Order 77-14, 296-62-20007, filed 7/25/77.]

WAC 296-62-20009 Methods of compliance. The employer shall control employee exposure to coke oven emissions by the use of engineer controls, work practices and respiratory protection as follows:

(1) Priority of compliance methods.

(a) Existing coke oven batteries.

(i) The employer shall institute the engineer and work practice controls listed in subsections (2), (3) and (4) of this section in existing coke oven batteries at the earliest possible time, but not later than January 20, 1980, except to the extent that the employer can establish that such controls are not feasible. In determining the earliest possible time for institution

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of engineer and work practice controls, the requirement, effective August 27, 1971, to implement feasible administrative or engineer controls to reduce exposures to coal tar pitch volatiles, shall be considered. Wherever the engineer and work practice controls which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest level achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of WAC 296-62-20011.

(ii) The engineer and work practice controls required under subsections (2), (3) and (4) of this section are minimum requirements generally applicable to all existing coke oven batteries. If, after implementing all controls required by subsections (2), (3) and (4) of this section, or after January 20, 1980, whichever is sooner, employee exposures still exceed the permissible exposure limit, employers shall implement any other engineer and work practice controls necessary to reduce exposure to or below the permissible exposure limit except to the extent that the employer can establish that such controls are not feasible. Whenever the engineer and work practice controls which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest level achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of WAC 296-62-20011.

(b) New or rehabilitated coke oven batteries.

(i) The employer shall institute the best available engineer and work practice controls on all new or rehabilitated coke oven batteries to reduce and maintain employee exposures at or below the permissible exposure limit, except to the extent that the employer can establish that such controls are not feasible. Wherever the engineer and work practice controls which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest level achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of WAC 296-62-20011.

(ii) If, after implementing all the engineer and work practice controls required by (b)(i) of this subsection, employee exposures still exceed the permissible exposure limit, the employer shall implement any other engineer and work practice controls necessary to reduce exposure to or below the permissible exposure limit except to the extent that the employer can establish that such controls are not feasible. Wherever the engineer and work practice controls which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest level achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of WAC 296-62-20011.

(c) Beehive ovens.

(i) The employer shall institute engineer and work practice controls on all beehive ovens at the earliest possible time to reduce and maintain employee exposures at or below the permissible exposure limit, except to the extent that the employer can establish that such controls are not feasible. In determining the earliest possible time for institution of engineer and work practice controls, the requirement, effective August 27, 1971, to implement feasible administrative or engineer controls to reduce exposures to coal tar pitch volatiles, shall be considered. Wherever the engineer and work practice controls

which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest level achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of WAC 296-62-20011.

(ii) If, after implementing all engineer and work practice controls required by (c)(i) of this subsection, employee exposures still exceed the permissible exposure limit, the employer shall implement any other engineer and work practice controls necessary to reduce exposures to or below the permissible exposure limit except to the extent that the employer can establish that such controls are not feasible. Whenever the engineer and work practice controls which can be instituted are not sufficient to reduce employee exposures to or below the permissible exposure limit, the employer shall nonetheless use them to reduce exposures to the lowest level achievable by these controls and shall supplement them by the use of respiratory protection which complies with the requirements of WAC 296-62-20011.

(2) **Engineer controls.**

(a) Charging. The employer shall equip and operate existing coke oven batteries with all of the following engineer controls to control coke oven emissions during charging operations:

(i) One of the following methods of charging:

(A) Stage charging as described in subsection (3)(a)(ii) of this section; or

(B) Sequential charging as described in subsection (3)(a)(ii) of this section except that subsection (3)(a)(ii) and (3)(d) of this section does not apply to sequential charging; or

(C) Pipeline charging or other forms of enclosed charging in accordance with (a) of this subsection, except (a)(ii), (iv), (v), (vi) and (viii) of this subsection do not apply.

(ii) Drafting from two or more points in the oven being charged, through the use of double collector mains, or a fixed or moveable jumper pipe system to another oven, to effectively remove the gases from the oven to the collector mains;

(iii) Aspiration systems designed and operated to provide sufficient negative pressure and flow volume to effectively move the gases evolved during charging into the collector mains, including sufficient steam pressure, and steam jets of sufficient diameter;

(iv) Mechanical volumetric controls on each larry car hopper to provide the proper amount of coal to be charged through each charging hole so that the tunnel head will be sufficient to permit the gases to move from the oven into the collector mains;

(v) Devices to facilitate the rapid and continuous flow of coal into the oven being charged, such as stainless steel liners, coal vibrators or pneumatic shells;

(vi) Individually operated larry car drop sleeves and slide gates designed and maintained so that the gases are effectively removed from the oven into the collector mains;

(vii) Mechanized gooseneck and standpipe cleaners;

(viii) Air seals on the pusher machine leveler bars to control air infiltration during charging; and

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(ix) Roof carbon cutters or a compressed air system or both on the pusher machine rams to remove roof carbon.

(b) Coking. The employer shall equip and operate existing coke oven batteries with all of the following engineer controls to control coke oven emissions during coking operations:

(i) A pressure control system on each battery to obtain uniform collector main pressure;

(ii) Ready access to door repair facilities capable of prompt and efficient repair of doors, door sealing edges and all door parts;

(iii) An adequate number of spare doors available for replacement purposes;

(iv) Chuck door gaskets to control chuck door emissions until such door is repaired, or replaced; and

(v) Heat shields on door machines.

(3) **Work practice controls.**

(a) **Charging.** The employer shall operate existing coke oven batteries with all of the following work practices to control coke oven emissions during the charging operation:

(i) Establishment and implementation of a detailed, written inspection and cleaning procedure for each battery consisting of at least the following elements:

(A) Prompt and effective repair or replacement of all engineer controls;

(B) Inspection and cleaning of goosenecks and standpipes prior to each charge to a specified minimum diameter sufficient to effectively move the evolved gases from the oven to the collector mains;

(C) Inspection for roof carbon build-up prior to each charge and removal of roof carbon as necessary to provide an adequate gas channel so that the gases are effectively moved from the oven into the collector mains;

(D) Inspection of the steam aspiration system prior to each charge so that sufficient pressure and volume is maintained to effectively move the gases from the oven to the collector mains;

(E) Inspection of steam nozzles and liquor sprays prior to each charge and cleaning as necessary so that the steam nozzles and liquor sprays are clean;

(F) Inspection of standpipe caps prior to each charge and cleaning and luting or both as necessary so that the gases are effectively moved from the oven to the collector mains; and

(G) Inspection of charging holes and lids for cracks, warpage and other defects prior to each charge and removal of carbon to prevent emissions, and application of luting material to standpipe and charging hole lids where necessary to obtain a proper seal.

WAC 296-62-20009 (Cont.)

(ii) Establishment and implementation of a detailed written charging procedure, designed and operated to eliminate emissions during charging for each battery, consisting of at least the following elements:

(A) Larry car hoppers filled with coal to a predetermined level in accordance with the mechanical volumetric controls required under subsection (2)(a)(iv) of this section so as to maintain a sufficient gas passage in the oven to be charged;

(B) The larry car aligned over the oven to be charged, so that the drop sleeves fit tightly over the charging holes; and

(C) The oven charged in accordance with the following sequence of requirements:

(I) The aspiration system turned on;

(II) Coal charged through the outermost hoppers, either individually or together, depending on the capacity of the aspiration system to collect the gases involved;

(III) The charging holes used under (a)(ii) and (b) of this subsection relidded or otherwise sealed off to prevent leakage of coke oven emissions;

(IV) If four hoppers are used, the third hopper discharged and relidded or otherwise sealed off to prevent leakage of coke oven emissions;

(V) The final hopper discharged until the gas channel at the top of the oven is blocked and then the chuck door opened and the coal leveled;

(VI) When the coal from the final hopper is discharged and the leveling operation complete, the charging hole relidded or otherwise sealed off to prevent leakage of coke oven emissions; and

(VII) The aspiration system turned off only after the charging holes have been closed.

(VIII) Establishment and implementation of a detailed written charging procedure, designed and operated to eliminate emissions during charging of each pipeline or enclosed charged battery.

(b) **Coking.** The employer shall operate existing coke oven batteries pursuant to a detailed written procedure established and implemented for the control of coke oven emissions during coking, consisting of at least the following elements:

(i) Checking oven back pressure controls to maintain uniform pressure conditions in the collecting main;

(ii) Repair, replacement and adjustment of oven doors and check doors and replacement of door jambs so as to provide a continuous metal-to-metal fit;

(iii) Cleaning of oven doors, chuck doors and door jambs each coking cycle so as to provide an effective seal;

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(iv) An inspection system and corrective action program to control door emissions to the maximum extent possible; and

(v) Luting of doors that are sealed by luting each coking cycle and reluting, replacing or adjusting as necessary to control leakage.

(c) **Pushing.** The employer shall operate existing coke oven batteries with the following work practices to control coke oven emissions during pushing operations:

(i) Coke and coal spillage quenched as soon as practicable and not shoveled into a heated oven; and

(ii) A detailed written procedure for each battery established and implemented for the control of emissions during pushing consisting of the following elements:

(A) Dampering off the ovens and removal of charging hole lids to effectively control coke oven emissions during the push;

(B) Heating of the coal charge uniformly for a sufficient period so as to obtain proper coking including preventing green pushes;

(C) Prevention of green pushes to the maximum extent possible;

(D) Inspection, adjustment and correction of heating flue temperatures and defective flues at least weekly and after any green push, so as to prevent green pushes;

(E) Cleaning of heating flues and related equipment to prevent green pushes, at least weekly and after any green push.

(d) **Maintenance and repair.** The employer shall operate existing coke oven batteries pursuant to a detailed written procedure of maintenance and repair established and implemented for the effective control of coke oven emissions consisting of the following elements:

(i) Regular inspection of all controls, including goosenecks, standpipes, standpipe caps, charging hole lids and castings, jumper pipes and air seals for cracks, misalignment or other defects and prompt implementation of the necessary repairs as soon as possible;

(ii) Maintaining the regulated area in a neat, orderly condition free of coal and coke spillage and debris;

(iii) Regular inspection of the damper system, aspiration system and collector main for cracks or leakage, and prompt implementation of the necessary repairs;

(iv) Regular inspection of the heating system and prompt implementation of the necessary repairs;

(v) Prevention of miscellaneous fugitive topside emissions;

(vi) Regular inspection and patching of over brickwork;

(vii) Maintenance of battery equipment and controls in good working order;

(viii) Maintenance and repair of coke oven doors, chuck doors, door jambs and seals; and

WAC 296-62-20009 (Cont.)

(ix) Repairs instituted and completed as soon as possible, including temporary repair measures instituted and completed where necessary, including but not limited to:

(A) Prevention of miscellaneous fugitive topside emissions; and

(B) Chuck door gaskets, which shall be installed prior to the start of the next coking cycle.

(4) **Filtered air.**

(a) The employer shall provide positive-pressure, temperature controlled filtered air for larry car, pusher machine, door machine, and quench car cabs.

(b) The employer shall provide standby pulpits on the battery topside, at the wharf, and at the screening station, equipped with positive-pressure, temperature controlled filtered air.

(5) **Emergencies.** Whenever an emergency occurs, the next coking cycle may not begin until the cause of the emergency is determined and corrected, unless the employer can establish that it is necessary to initiate the next coking cycle in order to determine the cause of the emergency.

(6) **Compliance program.**

(a) Each employer shall establish and implement a written program to reduce exposures solely by means of the engineer and work practice controls specified in subsections (2) through (4) of this section.

(b) The written program shall include at least the following:

(i) A description of each coke oven operation by battery, including work force and operating crew, coking time, operating procedures and maintenance practices;

(ii) Engineer plans and other studies used to determine the controls for the coke battery;

(iii) A report of the technology considered in meeting the permissible exposure limit;

(iv) Monitoring data obtained in accordance with WAC 296-62-20007.

(v) A detailed schedule for the implementation of the engineer and work practice controls specified in subsections (2) through (4) of this section; and

(vi) Other relevant information.

(c) If, after implementing all controls required by subsections (2) through (4) of this section, or after January 20, 1980, whichever is sooner, or after completion of a new or rehabilitated battery the permissible exposure limit is still exceeded, the employer shall develop a detailed written program and schedule for the implementation of any additional engineer controls and work practices necessary to reduce exposure to or below the permissible exposure limit.

(d) Written plans for such programs shall be submitted, upon request, to the director, and shall be available at the worksite for examination and copying by the director, and the authorized employee representative. The plans required under this subsection shall be revised and updated at least every six months to reflect the current status of the program.

WAC 296-62-20009 (Cont.)

(7) **Training in compliance procedures.** The employer shall incorporate all written procedures and schedules required under this section in the education and training program required under WAC 296-62-20019 and, where appropriate, post in the regulated area.

[Statutory Authority: Chapter 49.17 RCW. 88-23-054 (Order 88-25), 296-62-20009, filed 11/14/88. Statutory Authority: RCW 49.17.040 and 49.17.050. 86-16-009 (Order 86-28), 296-62-20009, filed 7/25/86; Order 77-14, 296-62-20009, filed 7/25/77.]

WAC 296-62-20011 Respiratory protection.

(1) **General.** For employees who use respirators required by this section, the employer must provide respirators that comply with the requirements of this section. Compliance with the permissible exposure limit may not be achieved by the use of respirators except during:

(a) Periods necessary to install or implement feasible engineering and work-practice controls;

(b) Work operations, such as maintenance and repair activity, for which engineering and work-practice controls are technologically not feasible;

(c) Work operations for which feasible engineering and work-practice controls are not yet sufficient to reduce employee exposure to or below the permissible exposure limit;

(d) Emergencies.

(2) **Respirator program.** The employer must implement a respiratory protection program as required by chapter 296-62 WAC, Part E (except WAC 296-62-07130(1) and 296-62-07150 through 296-62-07156).

(3) **Respirator selection.** The employer must select appropriate respirators or combination of respirators from Table I of this section.

TABLE I
RESPIRATORY PROTECTION FOR COKE OVEN EMISSIONS

Airborne concentration of coke oven emissions	Rerquired respirator
(i) Any concentration.	(A) A Type C supplied air respirator operated in pressure demand or other positive pressure or continuous flow mode; or (B) A powered air-purifying particulate filter respirator for dust, mist, and fume; or (C) A powered air-purifying particulate filter respirator combination chemical cartridge and particulate filter for coke oven emissions.
(ii) Concentrations not greater than 1500 $\mu g/m^3$.	(A) Any particulate filter respirator for dust, mist and fume, except single-use respirator; or (B) Any particulate filter respirator or combination chemical cartridge and particulate filter respirator for coke oven emissions; or (C) Any respirator listed in subsection (2)(a)(i) of this section.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-20011, filed 05/04/99, effective 09/01/99.] Statutory Authority: RCW 49.17.040 and 49.17.050. 86-16-009 (Order 86-28), 296-62-20011, filed 7/25/86. Statutory Authority: 49.17.040, 49.17.050, and 49.17.240. 81-16-015 (Order 81-20), 296-62-20011, filed 7/27/81; Order 77-14, 296-62-20011, filed 7/25/77.]

WAC 296-62-20013 Protective clothing and equipment.

(1) **Provision and Use.** The employer shall provide and assure the use of appropriate protective clothing and equipment, such as but not limited to:

(a) Flame resistant jacket and pants;

(b) Flame resistant gloves;

(c) Face shields or vented goggles which comply with WAC 296-800-160;

(d) Footwear providing insulation from hot surfaces;

(e) Safety shoes which comply with WAC 296-800-160; and

(f) Protective helmets which comply with WAC 296-800-160.

(2) **Cleaning and Replacement.**

(a) The employer shall provide the protective clothing required by subsection (1)(a) and (b) of this section in a clean and dry condition at least weekly.

(b) The employer shall clean, launder, or dispose of protective clothing required by subsections (1)(a) and (b) of this section.

(c) The employer shall repair or replace the protective clothing and equipment as needed to maintain their effectiveness.

(d) The employer shall assure that all protective clothing is removed at the completion of a work shift only in change rooms prescribed in WAC 296-62-20015.

(e) The employer shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the changeroom.

(f) The employer shall inform any person who cleans or launders protective clothing required by this section, of the potentially harmful effects of exposure to coke oven emissions.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-20013, filed 05/09/01, effective 09/01/01. Order 77-14, 296-62-20013, filed 7/25/77.]

WAC 296-62-20015 Hygiene facilities and practices.

(1) **Change rooms.** The employer shall provide clean change rooms equipped with storage facilities for street clothes and separate storage facilities for protective clothing and equipment whenever employees are required to wear protective clothing and equipment in accordance with WAC 296-62-20013.

(2) **Showers.**

(a) The employer shall assure that employees working in the regulated area shower at the end of the work shift.

(b) The employer shall provide shower facilities in accordance with WAC 296-24-12009.

(3) **Lunchrooms.** The employer shall provide lunchroom facilities which have a temperature controlled, positive pressure, filtered air supply, and which are readily accessible to employees working in the regulated area.

WAC 296-62-20015 (Cont.)

(4) **Lavatories.**

(a) The employer shall assure that employees working in the regulated area wash their hands and face prior to eating.

(b) The employer shall provide lavatory facilities in accordance with WAC 296-800-230.

(5) **Prohibition of activities in the regulated area.**

(a) The employer shall assure that in the regulated area, food or beverages are not present or consumed, smoking products are not present or used, and cosmetics are not applied, except, that these activities may be conducted in the lunchrooms, change rooms and showers required under subsection (1)-(3) of this section.

(b) Drinking water may be consumed in the regulated area.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-20015, filed 05/09/01, effective 09/01/01. Order 77-14, 296-62-20015, filed 7/25/77.]

WAC 296-62-20017 Medical surveillance.

(1) **General requirements.**

(a) Each employer shall institute a medical surveillance program for all employees who are employed in the regulated areas at least 30 days per year.

(b) This program shall provide each employee covered under subsection (1)(a) of this section with an opportunity for medical examinations in accordance with this section.

(c) The employer shall inform any employee who refuses any required medical examination of the possible health consequences of such refusal and shall obtain a signed statement from the employee indicating that the employee understands the risk involved in the refusal to be examined.

(d) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician, and are provided without cost to the employee.

(2) **Initial examinations.** At the time of initial assignment to a regulated area or upon the institution of the medical surveillance program, the employer shall provide a medical examination including at least the following elements:

(a) A work history and medical history which shall include smoking history and the presence and degree of respiratory symptoms, such as breathlessness, cough, sputum production, and wheezing;

(b) A 14" x 17" posterior-anterior chest x-ray and International Labour Office UICC/Cincinnati (ILO U/C) rating;

(c) Pulmonary function tests including forced vital capacity (FVC) and forced expiratory volume at one second (FEV 1.0) with recording of type of equipment used;

(d) Weight;

(e) A skin examination;

(f) Urinalysis for sugar, albumin, and hematuria; and

(g) A urinary cytology examination.

WAC 296-62-20017 (Cont.)

(3) **Periodic examinations.**

(a) The employer shall provide the examinations specified in subsections (2)(a)-(f) of this section at least annually for employees covered under subsection (1)(a) of this section.

(b) The employer shall provide the examinations specified in subsection (2)(a)and (c)-(g) of this section at least semi-annually for employees 45 years of age or older or with five or more years employment in the regulated area.

(c) Whenever an employee who is 45 years of age or older or with five or more years employment in the regulated area transfers or is transferred from employment in a regulated area, the employer shall continue to provide the examinations specified in subsections (2)(a)and (c)-(g) of this section semi-annually, as long as that employee is employed by the same employer or a successor employer.

(d) The employer shall provide the x-ray specified in subsection (2)(b) of this section at least annually for employees covered under this subsection.

(d) Whenever an employee has not taken the examination specified in subsections (3)(a)-(c) of this section within the six months preceding the termination of employment, the employer shall provide such examinations to the employee upon termination of employment.

(4) **Information provided to the physician.** The employer shall provide the following information to the examining physician:

(a) A copy of this regulation and its Appendixes;

(b) A description of the affected employee's duties as they relate to the employee's exposure;

(c) The employee's exposure level or anticipated exposure level;

(d) A description of any personal protective equipment used or to be used; and

(e) Information from previous medical examinations of the affected employee which is not readily available to the examining physician.

(5) **Physician's written opinion.**

(a) The employer shall obtain a written opinion from the examining physician which shall include:

(i) The results of the medical examinations;

(ii) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from exposure to coke oven emissions;

(iii) Any recommended limitations upon the employee's exposure to coke oven emissions or upon the use of protective clothing or equipment such as respirators; and

(iv) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further explanation or treatment.

(b) The employer shall instruct the physician not to reveal in the written opinion specific findings or diagnoses unrelated to occupational exposure.

WAC 296-62-20017 (Cont.)

(c) The employer shall provide a copy of the written opinion to the affected employee.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-17-094 (Order 99-01), § 296-62-20017, filed 08/17/99, effective 12/01/99. Statutory Authority: RCW 49.17.010, [49.17].040 and [49.17].050. 98-02-030, 296-62-20017, filed 12/31/97, effective 1/31/98; Order 77-14, 296-62-20017, filed 7/25/77.]

WAC 296-62-20019 Employee information and training.

(1) **Training program.**

(a) The employer shall institute a training program for employees who are employed in the regulated area and shall assure their participation.

(b) The training program shall be provided as of January 20, 1977, for employees who are employed in the regulated area at that time or at the time of initial assignment to a regulated area.

(c) The training program shall be provided at least annually for all employees who are employed in the regulated area, except that training regarding the occupational safety and health hazards associated with exposure to coke oven emissions and the purpose, proper use, and limitations of respiratory protective devices shall be provided at least quarterly until January 20, 1978.

(d) The training program shall include informing each employee of:

(i) The information contained in the substance information sheet for coke oven emissions (Appendix A);

(ii) The purpose, proper use, and limitations of respiratory protective devices in addition to other information as required by chapter 296-62 WAC, Part E (see WAC 296-62-07117, 296-62-07172, and 296-62-07186 through 296-62-07190).

(iii) The purpose for and a description of the medical surveillance program required by WAC 296-62-20017 including information on the occupational safety and health hazards associated with exposure to coke oven emissions;

(iv) A review of all written procedures and schedules required under WAC 296-62-20009; and

(v) A review of this standard.

(2) **Access to training materials.**

(a) The employer shall make a copy of this standard and its appendixes readily available to all employees who are employed in the regulated area.

(b) The employer shall provide all materials relating to the employee information and training program to the director.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-20019, filed 05/04/99, effective 09/01/99.] Statutory Authority: Order 77-14, 296-62-20019, filed 7/25/77.]

WAC 296-62-20021 Precautionary signs and labels.

(1) **General.**

(a) The employer may use labels or signs required by other statutes, regulations or ordinances in addition to, or in combination with, signs and labels required by this section.

(b) The employer shall assure that no statement appears on or near any sign required by this section which contradicts or detracts from the effects of the required sign.

WAC 296-62-20021(Cont.)

(c) The employer shall assure that signs required by this section are illuminated and cleaned as necessary so that the legend is readily visible.

(2) **Signs.**

(a) The employer shall post signs in the regulated area bearing the legends:

DANGER
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY
NO SMOKING OR EATING

(b) In addition, not later than January 20, 1978, the employer shall post signs in the areas where the permissible exposure limit is exceeded bearing the legend:

RESPIRATOR REQUIRED

(3) **Labels.** The employer shall apply precautionary labels to all containers of protective clothing contaminated with coke oven emissions. The label shall bear the following legend:

CAUTION
CLOTHING CONTAMINATED WITH COKE EMISSIONS
DO NOT REMOVE DUST BY BLOWING OR SHAKING

[Order 77-14, 296-62-20021, filed 7/25/77.]

WAC 296-62-20023 Recordkeeping.

(1) **Exposure measurements.** The employer shall establish and maintain an accurate record of all measurements taken to monitor employee exposure to coke oven emissions required in WAC 296-62-20007.

(a) This record shall include:

(i) Name, social security number, and job classification of the employees monitored;

(ii) The date(s), number, duration and results of each of the samples taken, including a description of the sampling procedure used to determine representative employee exposure where applicable;

(iii) The type of respiratory protective devices worn, if any;

(iv) A description of the sampling and analytical methods used and evidence of their accuracy; and

(v) The environment variables that could affect the measurement of employee exposure.

(b) The employer shall maintain this record for at least 40 years or for the duration of employment plus 20 years, whichever is longer.

(2) **Medical surveillance.** The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by WAC 296-62-20017.

(a) The record shall include:

WAC 296-62-20023 (Cont.)

(i) The name, social security number, and description of duties of the employee;

(ii) A copy of the physician's written opinion;

(iii) The signed statement of any refusal to take a medical examination under WAC 296-62-20017; and

(iv) Any employee medical complaints related to exposure to coke oven emissions.

(b) The employer shall keep, or assure that the examining physician keeps, the following medical records:

(i) A copy of the medical examination results including medical and work history required under WAC 296-62-20017;

(ii) A description of the laboratory procedures used and a copy of any standards or guidelines used to interpret the test results;

(iii) The initial x-ray;

(iv) The x-rays for the most recent 5 years;

(v) Any x-ray with a demonstrated abnormality and all subsequent x-rays;

(vi) The initial cytologic examination slide and written description;

(vii) The cytologic examination slide and written description for the most recent 10 years; and

(viii) Any cytologic examination slides with demonstrated atypia, if such atypia persists for 3 years, and all subsequent slides and written descriptions.

(c) The employer shall maintain medical records required under subsection (2) of this section for at least 40 years, or for the duration of employment plus 20 years, whichever is longer.

(3) **Availability.**

(a) The employer shall make available upon request all records required to be maintained by this section to the director for examination and copying.

(b) Employee exposure measurement records and employee medical records required by this subsection shall be provided upon request to employees, designated representatives, and the assistant director in accordance with WAC 296-62-05201 through 296-62-05209 and 296-62-05213 through 296-62-05217.

(c) The employer shall make available upon request employee medical records required to be maintained by subsection (2) of this section to a physician designated by the affected employee or former employee.

(4) **Transfer of records.**

(a) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by this section.

WAC 296-62-20023 (Cont.)

(b) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records for the prescribed period, these records shall be transmitted by registered mail to the director.

(c) At the expiration of the retention period for the records required to be maintained under subsections (1) and (2) of this section, the employer shall transmit these records by registered mail to the director or shall continue to retain such records.

(d) The employer shall also comply with any additional requirements involving transfer of records set forth in WAC 296-62-05215.

[Statutory Authority: RCW 49.17.040, 49.17.050 and 49.17.240. 81-18-029 (Order 81-21), 296-62-20023, filed 8/27/81; Order 77-14, 296-62-20023, filed 7/25/77.]

WAC 296-62-20025 Observation of monitoring.

(1) **Employee observation.** The employer shall provide affected employees or their representatives an opportunity to observe any measuring or monitoring of employee exposure to coke oven emissions conducted pursuant to WAC 296-62-20007.

(2) **Observation procedures.**

(a) Whenever observation of the measuring or monitoring of employee exposure to coke oven emissions requires entry into an area where the use of protective clothing or equipment is required, the employer shall provide the observer with and assure the use of such equipment and shall require the observer to comply with all other applicable safety and health procedures.

(b) Without interfering with the measurement, observers shall be entitled to:

(i) An explanation of the measurement procedures;

(ii) Observe all steps related to the measurement of coke oven emissions performed at the place of exposure; and

(iii) Record the results obtained.

[Order 77-14, 296-62-20025, filed 7/25/77.]

WAC 296-62-20027 Appendix A--Coke oven emissions substance information sheet.

APPENDIX A
COKE OVEN EMISSIONS
SUBSTANCE INFORMATION SHEET

I. SUBSTANCE IDENTIFICATION

(1) Substance: Coke oven emissions

(2) Definition: The benzene-soluble fraction of total particulate matter present during the destructive distillation or carbonization of coal for the production of coke.

(3) Permissible exposure limit: 150 micrograms per cubic meter of air determined as an average over an 8-hour period.

WAC 296-62-20027 (Cont.)

(4) Regulated areas: Only employees authorized by your employer should enter a regulated area. The employer is required to designate the following areas as regulated areas: the coke oven battery, including topside and its machinery, pushside and its machinery, and the screening station; and the wharf, the beehive ovens and machinery.

II. HEALTH HAZARD DATA

Exposure to coke oven emissions is a cause of lung cancer, and possibly kidney cancer, in humans. Although it does not have an excess number of skin cancer cases in humans, repeated skin contact with coke oven emissions should be avoided.

III. PROTECTIVE CLOTHING AND EQUIPMENT

(1) Respirators: Respirators will be provided by your employer for routine use if your employer is in the process of implementing engineering and work practice controls or where engineering and work practice controls are not feasible or insufficient. You must wear respirators for nonroutine activities or in emergency situations where you are likely to be exposed to levels of coke oven emissions in excess of the permissible exposure limit. Since how well your respirator fits your face is very important, your employer is required to conduct fit tests to make sure the respirator seals properly when you wear it. These tests are simple and rapid and will be explained to you during your training sessions.

(2) Protective clothing: Your employer is required to provide, and you must wear, appropriate, clean, protective clothing and equipment to protect your body from repeated skin contact with coke oven emissions and from the heat generated during the coking process. This clothing should include such items as jacket and pants and flame resistant gloves. Protective equipment should include face shield or vented goggles, protective helmets and safety shoes, insulated from hot surfaces where appropriate.

IV. HYGIENE FACILITIES AND PRACTICES

You must not eat, drink, smoke, chew gum or tobacco, or apply cosmetics in the regulated area, except that drinking water is permitted. Your employer is required to provide lunchrooms and other areas for these purposes.

Your employer is required to provide showers, washing facilities, and change rooms. If you work in a regulated area, you must wash your face, and hands before eating. You must shower at the end of the work shift. Do not take used protective clothing out of the change rooms without your employer's permission. Your employer is required to provide for laundering or cleaning of your protective clothing.

V. SIGNS AND LABELS

Your employer is required to post warning signs and labels for your protection. Signs must be posted in regulated areas. The signs must warn that a cancer hazard is present, that only authorized employees may enter the area, and that no smoking or eating is allowed. In regulated areas where coke oven emissions are above the permissible exposure limit, the signs should also warn that respirators must be worn.

VI. MEDICAL EXAMINATIONS

If you work in a regulated area at least 30 days per year, your employer is required to provide you with a medical examination every year. The medical examination must include a medical history, a chest x-ray; pulmonary function test; weight comparison; skin examination; a urinalysis and a urine cytology exam for the early detection of urinary cancer. The urine cytology exam is only included in the initial exam until you are either forty-five years or older, or have five or more years employment in the regulated areas when the medical exams including this test, but excepting the x-ray exam, are to be given every six months; under these conditions, you are to be given an x-ray exam at least once a year. The examining physician will provide a written opinion to your employer containing the results of the medical exams. You should also receive a copy of this opinion.

WAC 296-62-20027 (Cont.)

VII. OBSERVATION OF MONITORING

Your employer is required to monitor your exposure to coke oven emissions and you are entitled to observe the monitoring procedure. You are entitled to receive an explanation of the measurement procedure, observe the steps taken in the measurement procedure, and to record the results obtained. When the monitoring procedure is taking place in an area where respirators or personal protective clothing and equipment are required to be worn, you must also be provided with and must wear the protective clothing and equipment.

VIII. ACCESS TO RECORDS

You or your representative are entitled to records of your exposure to coke oven emissions upon request to your employer. Your medical examination records can be furnished to your physician upon request to your employer.

IX. TRAINING AND EDUCATION

Additional information on all of these items plus training as to hazards of coke oven emissions and the engineering and work practice controls associated with your job will also be provided by your employer.
[Statutory Authority: RCW 49.17.010, .040, .050. 99-17-094 (Order 99-01), § 296-62-20027, filed 08/17/99, effective 12/01/99. Statutory Authority: RCW 49.17.010, .040, .050. 99-10 (Order 98-10) § 296-62-20027, filed 05/04/99, effective 09/01/99.] Statutory Authority: RCW 49.17.010, [49.17].040 and [49.17].050. 98-02-030, 296-62-20027, filed 12/31/97, effective 1/31/98; Order 77-14, Appendix A (codified as WAC 296-62-20027), filed 7/25/77.]

WAC 296-62-20029 Appendix B--Industrial hygiene and medical surveillance guidelines.

APPENDIX B
INDUSTRIAL HYGIENE AND MEDICAL SURVEILLANCE GUIDELINES

I. INDUSTRIAL HYGIENE GUIDELINES

(1) **Sampling.** (Benzene-Soluble Fraction Total Particulate Matter.)

Samples collected should be full shift (8-hour) samples. Sampling should be done using a personal sampling pump with pulsation damper at a flow rate of 2 liters per minute. Samples should be collected on 0.8 micrometer pore size silver membrane filters (37 mm diameter) preceded by Gelman glass fiber type A filters encased in three-piece plastic (polystyrene) field monitor cassettes. The cassette face cap should be on and the plug removed. The rotameter should be checked every hour to ensure that proper flow rates are maintained.

A minimum of three full-shift samples should be collected for each job classification on each battery, at least one from each shift. If disparate results are obtained for particular job classification, sampling should be repeated. It is advisable to sample each shift on more than one day to account for environmental variables (wind, precipitation, etc.) which may affect sampling. Differences in exposures among different work shifts may indicate a need to improve work practices on a particular shift. Sampling results from different shifts for each job classification should not be averaged. Multiple samples from same shift may be used to calculate an average exposure for a particular job classification.

(2) **Analysis.**

(a) All extraction glassware is cleaned with dichromic acid cleaning solution, rinsed with tap water, then deionized water, acetone, and allowed to dry completely. The glassware is rinsed with nanograde benzene before use. The Teflon cups are cleaned with benzene then with acetone.

WAC 296-62-20029 (Cont.)

(b) Pre-weigh the 2 ml Perkin-Elmer Teflon cups to one hundredth of a milligram on a Perkin-Elmer autobalance AD 2 Tare weight of the cups is about 50 mg.

(c) Place the silver membrane filter and glass fiber filter into a 15 ml test tube.

(d) Extract with 5 ml of benzene for five minutes in an ultrasonic cleaner.

(e) Filter the extract in 15 ml medium glass fritted funnels.

(f) Rinse test tube and filters with two 1.5 ml aliquots of benzene and filter through the fritted glass funnel.

(g) Collect the extract and two rinses in a 10 ml Kontes graduated evaporative concentrator.

(h) Evaporate down to a 1 ml while rinsing the sides with benzene.

(i) Pipet 0.5 ml into the Teflon cup and evaporate to dryness in a vacuum oven at 40ø C for 3 hours.

(j) Weight the Teflon cup and the weight gain is due to the benzene soluble residue in half the sample.

II. MEDICAL SURVEILLANCE GUIDELINES

(1) **General.**

The minimum requirements for the medical examination for coke oven workers are given in WAC 296-62-20017.

The initial examination is to be provided to all coke oven workers who work at least thirty days in the regulated area. The examination includes a 14" x 17" posterior-anterior chest x-ray and a ILO/UC rating to assure some standardization of x-ray reading, pulmonary function tests (FVC and FEV 1.0), weight, urinalysis, skin examination and a urinary cytologic examination. These tests are to serve as the baseline for comparing the employee's future test results. Periodic exams include all the elements of the initial exams, except that the urine cytologic test is to be performed only on those employees who are forty-five years of age or older or who have worked for five or more years in the regulated area; periodic exams, with the exception of x-rays, are to be performed semiannually for this group instead of annually; for this group, x-rays will continue to be given at least annually. The examination contents are minimum requirements, additional tests such as lateral and oblique x-rays or additional pulmonary function tests may be performed if deemed necessary.

(2) **Pulmonary function tests.**

Pulmonary function tests should be performed in a manner which minimizes subject and operator bias. There has been shown to be learning effects with regard to the results obtained from certain tests, such as FEV 1.0. Best results can be obtained by multiple trials for each subject. The best of three trials or the average of the last three of five trials may be used in obtaining reliable results. The type of equipment used (manufacturer, model, etc.) should be recorded with the results as reliability and accuracy varies and such information may be important in the evaluation of test results. Care should be exercised to obtain the best possible testing equipment.

[Statutory Authority: RCW 49.17.010, .040, .050. 99-17-094 (Order 99-01), § 296-62-20029, filed 08/17/99, effective 12/01/99. Statutory Authority: RCW 49.17.010, [49.17].040 and [49.17].050. 98-02-030, 296-62-20029, filed 12/31/97, effective 1/31/98; Order 77-14, Appendix B (codified as WAC 296-62-20029), filed 7/25/77.]

PART P
HAZARDOUS WASTE OPERATIONS AND TREATMENT, STORAGE, AND DISPOSAL FACILITIES

WAC

WAC

296-62-300 Hazardous waste operations and treatment, storage, and disposal facilities.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-300, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-300, filed 7/20/94, effective 9/20/94; 91-24-017 (Order 91-07), 296-62-300, filed 11/22/91, effective 12/24/91; 90-20-091 (Order 90-14), 296-62-300, filed 10/1/90, effective 11/15/90; 89-21-018 (Order 89-10), 296-62-300, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-300, filed 10/6/88, effective 11/7/88.]

WAC 296-62-30001 Scope and application

(1) Scope. This section covers employers who have employees who work in the following operations:

(a) Clean-up operations required by a governmental body, whether federal, state, local, or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);

(b) Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 et seq.);

(c) Voluntary clean-up operations at sites recognized by federal, state, local, or other governmental bodies as uncontrolled hazardous waste sites;

(d) Operations involving hazardous wastes that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR Parts 264 and 265 under RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations.

(2) Application.

(a) All requirements of this chapter and chapters 296-24, 296-155, and 296-800 WAC apply to hazardous waste operations whether covered by this part or not. If there is a conflict or overlap, the provision more protective of employee safety and health must apply.

(b) Hazardous substance clean-up operations within the scope of subsection (1)(a), (b), and (c) of this section must comply with all sections of WAC 296-62-410, Part R, Emergency response to hazardous substance release.

(c) Operations within the scope of subsection (1)(d) of this section must comply only with the requirements of WAC 296-62-3140 through 296-62-31430.

Notes and Exceptions:

(i) All provisions of WAC 296-62-3140 through 296-62-31430 cover any treatment, storage, or disposal (TSD) operation regulated by 40 CFR Parts 264 and 265 or by state law authorized under RCRA, and required to have a permit or interim status from EPA under 40 CFR 270.1 or from a state agency under RCRA.

(ii) Employers who are not required to have a permit or interim status because they are conditionally exempt small quantity generators under 40 CFR 261.5 or are generators who qualify under 40 CFR 262.34 for exemptions from regulation under 40 CFR Parts 264, 265, and 270 ("excepted employers") are not covered by WAC 296-62-31405 through 296-62-31445. Excepted employers who are required by the EPA or state agency to have their employees engage in emergency response or who direct their employees to engage in emergency response are covered by WAC 296-62-31450 through 296-62-31470 and cannot be exempted by WAC 296-62-31455. Excepted employers who are not required to have employees engage in emergency response, who direct their employees to evacuate in the case of such emergencies and who meet the requirements of WAC 296-62-31455 are exempt from the balance of WAC 296-62-31450 through 296-62-31470.

WAC 296-62-30001 (Cont.)

(iii) If an area is used primarily for treatment, storage or disposal, any emergency response operations in that area must comply with WAC 296-62-31410 through 296-62-31470. In other areas not used primarily for treatment, storage or disposal, any emergency response operations must comply with WAC 296-62-410, Part R, Emergency response to hazardous substance release. Compliance with the requirements of WAC 296-62-410, Part R, Emergency response to hazardous substance release must be deemed to be in compliance with the requirements of WAC 296-62-31450 through 296-62-31470.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-30001, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-18), § 296-62-30001, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30003 Definitions.

"Buddy system" means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

"Clean-up operation" means an operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleared-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

"Contamination reduction zone" means the buffer between the exclusion zone and the outermost clean zone.

"Decontamination" means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health effects.

"Emergency response" or **"responding to emergencies"** means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to release of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

"Exclusion zone" means the innermost zone at a site where contamination does occur.

"Facility" means:

Any building structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly-owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft; or

Any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

"Hazardous substance" means any substance designated or listed under this definition, exposure to which results or may result in adverse effects on the health or safety of employees:

Any substance defined under section 101(14) of CERCLA;

Any biological agent and other disease-causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease,

behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring;

WAC 296-62-30003 (Cont.)

Any substance listed by the United States Department of Transportation as hazardous materials under WAC 480-12-195; and

Hazardous waste as herein defined.

"**Hazardous waste"** means:

A waste or combination of wastes as defined as a **"health hazard."**

"Hazardous waste operation" means any operation conducted within the scope of this standard.

"Hazardous waste site" or **"site"** means any facility or location within the scope of this standard at which hazardous waste operations take place.

"Health hazard" means a chemical, mixture of chemicals, or a pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. It also includes stress due to temperature extremes. Further definition of the terms used above can be found in Appendix A to chapter 296-62 WAC, Part C.

"IDLH" or **"immediately dangerous to life or health"** means any atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

"Oxygen deficiency" means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

"Permissible exposure limit" means the exposure, inhalation, or dermal permissible limit specified in WAC 296-62-075 through 296-62-07515.

"Published exposure level" means the exposure limits published in "NIOSH Recommendations for Occupational Health Standards" dated 1986 incorporated by reference, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication "Threshold Limit Values and Biological Exposure Indices for 1988-89" dated 1988 incorporated by reference.

"Postemergency response" means that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If postemergency response is performed by an employer's own employees who were part of the initial emergency response, it is considered to be part of the initial response and not postemergency response. However, if a group of an employer's own employees, separate from the group providing initial response, performs the clean-up operation, then the separate group of employees would be considered to be performing postemergency response and subject to chapter 296-62 WAC, Part R.

"Qualified person" means a person with specific training, knowledge, and experience in the area for which the person has responsibility and the authority to control.

"Site safety and health supervisor (or official)" means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

"Site work zones" means an exclusion zone, contamination reduction zone, and a clean zone established at a hazardous waste site before clean-up work begins to prevent or reduce the movement of contaminants from the site to uncontaminated areas and to control public, employee, and equipment exposure to hazardous substances.

WAC 296-62-30003 (Cont.)

The exclusion zone is the innermost of the zones and is where contamination does occur. The contamination reduction zone is the zone between the exclusion zone and the clean zone and serves as a transition and buffer between the contaminated and clean zone to further reduce the physical transfer of contaminating substances to the public, employees, and equipment. The clean zone is the outermost of the zones and is a noncontaminated or clean area. The level of contamination in these zones is not defined and some designated exclusion zones can have very little contamination directly affecting employees.

The contaminated reduction corridors are the designated areas within the contaminated reduction zone for the decontamination of personnel and equipment.

"Small quantity generator" means a generator of hazardous wastes who in any calendar month generates no more than 1000 kilograms (2205 pounds) of hazardous waste in that month.

"Uncontrolled hazardous waste site" means an area identified as an uncontrolled hazardous waste site by a governmental body, whether federal, state, local, or other where an accumulation of hazardous substances creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands, such as those created by former municipal, county, or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous substance waste. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by this definition.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30003, filed 03/23/99, effective 06/23/99.}

WAC 296-62-3010 Overview of a written safety and health program.

Note: Safety and health programs developed and implemented to meet other federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this section. An additional or separate safety and health program is not required by this section.

Employers must develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program must be designed to identify, evaluate, and control safety and health hazards and provide for emergency response for hazardous waste operations.
[Statutory Authority: 99-07-097 (Order 98-38), § 296-62-3010, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 95-04-007, 296-62-3010, filed 1/18/95, effective 3/1/95; 89-21-018 (Order 89-10), 296-62-3010, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3010, filed 10/6/88, effective 11/7/88.]

WAC 296-62-30105 Elements of a safety and health program. The written safety and health program must include the following elements:

(1) An organizational structure;

(2) A comprehensive workplan;

(3) A site-specific safety and health plan which need not repeat the employer's standard operating procedures required in subsection (7) of this section;

(4) The safety and health training program;

(5) The medical surveillance program;

(6) The employer's standard operating procedures for safety and health; and

(7) Any necessary interface between general program and site specific activities.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30105, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30110 Safety considerations during the initial site excavation. Site excavations created during initial site preparation or during hazardous waste operations must be shored or sloped as appropriate to prevent accidental collapse in accordance with subpart N of chapter 296-155 WAC.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30110, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30115 Notifying contractors and subcontractors of procedures and hazards. An employer who retains contractor or subcontractor services for work in hazardous waste operations must inform those contractors, subcontractors, or their representatives of the site emergency response procedures and any potential fire, explosion, health, safety, or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30115, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30120 Availability of the safety and health program. The written safety and health program must be made available to any contractor or subcontractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to WISHA personnel, and to personnel of other federal, state, or local agencies with regulatory authority over the site.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30120, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30125 Organizational structure of the site safety and health program.

(1) The organizational structure of the site safety and health program must establish the specific chain of command and specify the overall responsibilities of supervisors and employees. It must include at a minimum, the following elements:

(a) A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(b) A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(c) All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.

(d) The lines of authority, responsibility, and communication.

(2) The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30125, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30130 Comprehensive workplan of the site program. The comprehensive workplan must address the tasks and objectives of site operations and the logistics and resources required to reach those tasks and objectives. The comprehensive workplan must:

(1) Address anticipated clean-up activities as well as normal operating procedures which need not repeat the employers procedures available elsewhere.

(2) Define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(3) Establish personnel requirements for implementing the plan.

(4) Provide for the implementation of the training required in WAC 296-62-3040.

(5) Provide for the implementation of the required informational programs required in WAC 296-62-3080.

(6) Provide for the implementation of the medical surveillance program described in WAC 296-62-3050 through 296-62-30535.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30130, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30135 Overview of a site-specific safety and health plan.

(1) A written site-specific safety and health plan, must be kept on site. It must address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection.

(2) Elements of a site-specific safety and health plan. The site-specific safety and health plan must include the following elements:

(a) The names of key personnel and alternates responsible for site safety and health, including a site safety and health supervisor.

(b) A safety and health risk or hazard analysis for each site task and operation found in the workplan.

(c) Employee training assignments to assure compliance with WAC 296-62-3040 through 296-62-30465.

(d) Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in WAC 296-62-30615.

(e) A medical surveillance program meeting the requirements in WAC 296-62-3050 through 296-62-30535.

(f) Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

(g) Site control measures in WAC 296-62-3030 through 296-62-30315.

(h) Decontamination procedures in WAC 296-62-3100 through 296-62-31015.

(i) An emergency response plan meeting the requirements of chapter 296-62 WAC, Part R for safe and effective responses to emergencies, including the necessary PPE and other equipment.

(j) Confined space and permit-required confined space entry procedures as addressed in chapter 296-62 WAC, Part M.

(k) A spill containment program meeting the requirements of WAC 296-62-3090 through 296-62-30940.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30135, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30140 Preentry briefing of the site-specific safety and health plan. The site-specific safety and health plan must provide for preentry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in WAC 296-62-3020 through 296-62-30235 must be used to prepare and update the site safety and health plan.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30140, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30145 Effectiveness of site safety and health plan. Inspections must be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan must be corrected by the employer.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30145, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3020 Site characterization and analysis. Hazardous waste sites must be evaluated in accordance with this section to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3020, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30205 Preliminary evaluation. A preliminary evaluation of a site's characteristics must be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics must be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30205, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30210 Hazard identification. All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm, must be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30210, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30215 Required information. The following information to the extent available must be obtained by the employer prior to allowing employees to enter a site:

(1) Location and approximate size of the site.

(2) Description of the response activity and/or the job task to be performed.

(3) Duration of the planned employee activity.

(4) Site topography and accessibility by air and roads.

(5) Safety and health hazards expected at the site.

(6) Pathways for hazardous substance dispersion.

(7) Present status and capabilities of emergency response teams that would provide assistance to hazardous waste clean-up site employees at the time of an emergency.

(8) Hazardous substances and health hazards involved or expected at the site and their chemical and physical properties.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30215, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30220 Personal protective equipment. Personal protective equipment (PPE) must be provided and used during initial site entry in accordance with the following requirements:

(1) Based upon the results of the preliminary site evaluation, an ensemble of PPE must be selected and used during initial site entry which will provide protection to a level of exposure below established permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards, and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate personal protective equipment. Level A and Level B personal protective equipment is required for the most hazardous actual or potential exposures.

(2) If positive-pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five minute's duration must be carried by employees during initial site entry.

WAC 296-62-30220 (Cont.)

(3) If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site an ensemble providing protection equivalent to Level B PPE must be provided as minimum protection and direct reading instruments must be used as appropriate for identifying IDLH conditions. (See WAC 296-62-3170 - Appendix B for a description of Level B hazards and the recommendations for Level B protective equipment.)

(4) Once the hazards of the site have been identified, the appropriate PPE must be selected and used in accordance with WAC 296-62-3060 through 296-62-30615.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30220, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30225 Monitoring. The following monitoring must be conducted during initial site entry when the site evaluation produces information that shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient to rule out these possible conditions:

(1) Monitoring with direct reading instruments for hazardous levels of ionizing radiation.

(2) Monitoring the air with appropriate direct reading equipment (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances).

(3) Visually observing for signs of actual or potential IDLH or other dangerous conditions.

(4) An ongoing air monitoring program in accordance with WAC 296-62-30710 and 296-62-30715 must be implemented after site characterization has determined the site is safe for the start-up of operations.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30225, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30230 Risk identification. Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances must be identified. Employees who will be working on the site must be informed of any risks that have been identified. In situations covered by WAC 296-800-170, training required by those standards need not be duplicated.

Note: Risks to consider include, but are not limited to:

(1) Exposures exceeding the permissible exposure limits and published exposure levels.

(2) IDLH concentrations.

(3) Potential skin absorption and irritation sources.

(4) Potential eye irritation sources.

(5) Explosion sensitivity and flammability ranges.

(6) Oxygen deficiency.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-30230, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30230, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30235 Employee notification. Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform must be made available to all employees prior to the commencement of their work activities. The employer may use information developed for the chemical hazard communication standard, WAC 296-800-170, for this purpose.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-30235, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30235, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3030 Site control. Appropriate site control procedures must be implemented to control employee exposure to hazardous substances before clean-up work begins.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3030, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 89-21-018 (Order 89-10), 296-62-3030, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3030, filed 10/6/88, effective 11/7/88.]

WAC 296-62-30305 Site control program. A site control program for protecting employees which is part of the employer's site safety health program required in WAC 296-62-3010 through 296-62-30145 must be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30305, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30310 Elements of the site control program. The site control program must, as a minimum, include: A site map; site work zones; the use of a "buddy system"; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and, identification of nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30310, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30315 Site work zones.

(1) The site work zones must be the exclusion zone, contamination reduction zone, and the clean zone.

(2) Decontamination procedures must take place in the contamination reduction corridor consisting, if practical, of separate corridors for personnel and for equipment.

(3) An entry an exit check point must be established at the boundary of the exclusion zone to regulate the flow of personnel and equipment into and out of the zone. Exit from the exclusion zone must be through a contamination reduction corridor.

(4) Access to the contamination reduction zone from the clean zone is through a control point. Personnel entering or working in the contamination zone must wear the prescribed personnel protective equipment, if required, for working in this zone. Entering the clean zone requires removal of any protective equipment worn in the contamination reduction zone.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30315, filed 03/23/99, effective 06/23/99.

WAC 296-62-3040 General training requirements and the employees covered.

(1) All employees working on site (such as but not limited to equipment operators, general laborers, and others) exposed to hazardous substances, health hazards, or safety hazards, and their supervisors and management responsible for the site, must receive training meeting the requirements of this subsection before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they must review training as specified in this subsection.

(2) Employees must not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3040, filed 03/23/99, effective 06/23/99.

WAC 296-62-30405 Elements covered in training. The training must thoroughly cover the following:

(1) Names of personnel and alternates responsible for site safety and health;

(2) Safety, health, and other hazards present on the site;

(3) Use of personal protective equipment;

(4) Work practices by which the employee can minimize risks from hazards;

WAC 296-62-30405 (Cont.)

(5) Safe use of engineering controls and equipment on the site;

(6) Medical surveillance requirements including recognition of symptoms and signs which might indicate overexposure to hazards; and

(7) The contents of the site safety and health plan set forth in WAC 296-62-31035 (2)(g) through (j).

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30405, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30410 Initial training. General site workers (such as equipment operators, general laborers, and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards must receive the following required training:

(1) General site workers required to wear Level A or Level B personal protective equipment because of the types of hazards to which they are exposed or have the potential for being exposed are required to have 80 hours of training and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

(2) General site workers required to wear Level C or D personal protective equipment, equipment operators or transport vehicle operators, are required to have 40 hours of training and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

(3) General site workers on site only occasionally for specific limited tasks, and supervisors not working in the two inner zones are required to have 24 hours of training. For example, certain Environmental Protection Agency, and department of ecology employees, labor and industries inspectors and other short-term monitoring and surveying personnel would be required to only have 24 hours of training if they are on-site only occasionally for a specific limited task and are unlikely to be exposed over permissible exposure levels and published exposure limits. A minimum of one day actual field experience under direct supervision is also required.

(4) Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, must receive a minimum of 24 hours of instruction off the site and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(5) Workers with 24 hours of training who are covered by subsections (3) and (4) of this section, and who become general site workers or who are required to wear respirators, must have the additional 16 hours and two days of training necessary to total the training specified in subsection (2) of this section.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30410, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30415 Management and supervisor training. On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations must receive the same initial training as listed in WAC 296-62-30410, and three days of supervised field experience and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30415, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30420 Law enforcement at illicit drug labs.

Exception: *WISHA did not intend application of the 80 hour training requirement to law enforcement personnel required to enter illicit drug labs, secure the premise, and obtain necessary evidence for law enforcement purposes. Attendance at a specific 40 hours course, such as that presented by the criminal justice training commission, is acceptable.*

WAC 296-62-30420 (Cont.)

Note: If clean-up activities are conducted by law enforcement personnel, then appropriate hazardous waste clean-up training would be required.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30420, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30425 Training course content for 40 and 80 hour hazardous waste clean-up courses. As a minimum, the training course content for the 40 hour and 80 hour training program must include the following topics:

(1) Overview of the applicable sections of Part P of chapter 296-62 WAC and the elements of an employer's effective occupational safety and health program.

(2) Effect of chemical exposure to hazardous substances (i.e., toxicity, carcinogens, irritants, sensitizers, etc.).

(3) Effects of biological and radiological exposures.

(4) Fire and explosion hazards (i.e., flammable and combustible liquids, reactive materials).

(5) General safety hazards, including electrical hazards, powered equipment hazards, walking-working surface hazards and those hazards associated with hot and cold temperature extremes.

(6) Permit-required confined space, tank, and vault hazards and entry procedures.

(7) Names of personnel and alternates, where appropriate, responsible for site safety and health at the site.

(8) Specific safety, health, and other hazards that are to be addressed at a site and in the site safety and health plan.

(9) Use of personal protective equipment and the implementation of the personal protective equipment program.

(10) Work practices that will minimize employee risk from site hazards.

(11) Safe use of engineering controls and equipment and any new relevant technology or procedure.

(12) Content of the medical surveillance program and requirements, including the recognition of signs and symptoms of overexposure to hazardous substances.

(13) The contents of an effective site safety and health plan.

(14) Use of monitoring equipment with “hands-on” experience and the implementation of the employee and site monitoring program.

(15) Implementation and use of the information program.

(16) Drum and container handling procedures and the elements of a spill containment program.

(17) Selection and use of material handling equipment.

(18) Methods for assessment of risk and handling of radioactive wastes.

(19) Methods for handling shock-sensitive wastes.

(20) Laboratory waste pack handling procedures.

(21) Container sampling procedures and safeguards.

(22) Safe preparation procedures for shipping and transport of containers.

WAC 296-62-30425 (Cont.)

(23) Decontamination program and procedures.

(24) Emergency response plan and procedures including first aid.

(25) Safe site illumination levels.

(26) Site sanitation procedures and equipment for employee needs.

(27) Review of the applicable appendices to Part P of chapter 296-62 WAC.

(28) Overview and explanation of WISHA's chemical hazard communication standard WAC 296-800-170.

(29) Sources of reference, additional information and efficient use of relevant manuals and hazard coding systems.

(30) Principles of toxicology and biological monitoring.

(31) Rights and responsibilities of employees and employers under WISHA and CERCLA.

(32) Hands-on field exercises and demonstrations.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-30425, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30425, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30430 Training content for 24-hour hazardous waste clean-up course. As a minimum, the 24-hour training course required in WAC 296-62-30410 (3) and (4) for employees engaged in occasional visits to uncontrolled hazardous waste sites must include the following topics where they are applicable to the job function to be performed:

(1) Overview of applicable sections of Part P of chapter 296-62 WAC and the elements of the employer's effective occupational safety and health program.

(2) Employee rights and responsibilities under WISHA and CERCLA.

(3) Overview of relevant chemical exposures to hazardous substances (i.e., toxics, carcinogens, irritants, sensitizers, etc.).

(4) Overview of the principles of toxicology and biological monitoring.

(5) Use of monitoring equipment with hands-on practice and an overview of a site monitoring program.

(6) Overview of site hazards including fire and explosion, confined spaces, oxygen deficiency, electrical hazards, powered equipment hazards, walking-working surface hazards.

(7) The contents of an effective site safety and health plan.

(8) Use of personal protective equipment and the implementation of the personal protective equipment program.

(9) Work practices that will minimize employee risk from site hazards.

(10) Site simulations with “hands-on” exercises and practice.

(11) Emergency response planning and response including first aid.

(12) Content of the medical surveillance program and requirements, including the recognition of signs and symptoms of overexposure to hazardous substances.

(13) Decontamination programs and procedures.

WAC 296-62-30430 (Cont.)

(14) Safe use of engineering controls and equipment.

(15) Sources of references and efficient use of relevant manuals and knowledge of hazard coding systems.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30430, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30435 16-hour supplemental training for hazardous waste sites. As a minimum, employees who have received 24 hours of training for hazardous waste site operations must receive training in the following topics before they are allowed to work as general site workers or if they are required to wear respirators:

(1) Relevant chemical exposures to hazardous substances beyond that previously covered.

(2) Site hazards including fire and explosion, confined spaces, oxygen deficiency, electrical, powered equipment, and walking-working surfaces beyond that previously covered.

(3) Names of personnel and alternates responsible for site safety and health at the site, where appropriate.

(4) Use of monitoring equipment and the implementation of the employee and the site monitoring program beyond that previously covered.

(5) Implementation and use of the informational program.

(6) Drum and container handling procedures and the elements of a spill containment program.

(7) Selection and use of material handling equipment.

(8) Methods for assessment of risk and handling of radioactive wastes.

(9) Methods for handling shock-sensitive wastes.

(10) Laboratory waste pack handling procedures.

(11) Container sampling procedures and safeguards.

(12) Safe preparation procedures for shipping and transport of containers.

(13) Decontamination program and procedures.

(14) Safety site illumination levels.

(15) Site sanitation procedures and equipment.

(16) Review of the applicable appendices to Part P of chapter 296-62 WAC.

(17) Overview and explanation of WISHA's chemical hazard communication standard WAC 296-800-170.

(18) Sources of reference and additional information.
[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-30435, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30435, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30440 Additional 8 hours of training for supervisors and managers. Supervisors and managers must receive an additional eight hours of training in the following subjects:

(1) Management of hazardous wastes and their disposal.

(2) Federal, state, and local agencies to be contacted in the event of a release of hazardous substances.

WAC 296-62-30440 (Cont.)

(3) Management of emergency procedures in the event of a release of hazardous substances.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30440, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30445 Qualifications for trainers. Trainers must be qualified to instruct employees about the subject matter that is being presented in training. Such trainers must have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they must have the academic credentials and instructional experience necessary for teaching the subjects. Instructors must demonstrate competent instructional skills and knowledge of the applicable subject matter.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30445, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30450 Training certification. Employees and supervisors that have received and successfully completed the training and field experience specified in WAC 296-62-3040 through 296-62-30415 must be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate must be given to each person certified. Any person who has not been certified or who does not meet the requirements of WAC 296-62-30465 must be prohibited from engaging in hazardous waste operations.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30450, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30455 Training requirements for emergency response. Employees who are engaged in responding to hazardous emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances must be trained in how to respond to expected emergencies.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30455, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30460 Refresher training. Employees specified in WAC 296-62-3040 and managers specified in WAC 296-62-30415 must receive eight hours of refresher training annually on the items specified in WAC 296-62-30405 and/or 296-62-30415, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30460, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30465 Equivalent training. Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in WAC 296-62-3040 through 296-62-30410 must not be required to provide the initial training requirements of those sections to such employees and must provide a copy of the certification or documentation to the employee upon request. However, certified employees or employees with equivalent training new to a site must receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience. The 80 hours of instruction required can be fulfilled as follows:

(1) Instruction can include a combination of presently available 40 hour training sessions and other related classes or training including additional supervised on-the-job training as long as material covered includes elements required in the training section WAC 296-62-30405 of the regulations. A single 80 hour training session is also acceptable.

(2) Previously attended courses including eight-hour refresher courses apply toward the 80 hour requirement and need not be repeated.

(3) Documentation of previous experience and training by qualified trainers is required of employers and must be available to inspectors for review.

(4) When calculating hours of training, WISHA assumes a “normal” work day to be eight hours with sufficient time for lunch and other breaks.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30465, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3050 Medical surveillance. Employers engaged in operations specified in WAC 296-62-300(1) and not covered by WAC 296-62-300(2), exceptions; must institute a medical surveillance program.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3050, filed 03/23/99, effective 06/23/99.] [Statutory Authority: Chapter 49.17 RCW. 91-11-070 (Order 91-01), 296-62-3050, filed 5/20/91, effective 6/20/91; 90-20-091 (Order 90-14), 296-62-3050, filed 10/1/90, effective 11/15/90; 89-21-018, 296-62-3050, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3050, filed 10/6/88, effective 11/7/88.]

WAC 296-62-30505 Employees covered. The medical surveillance program must be instituted for the following employees:

(1) All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;

(2) All employees who wear a respirator for 30 days or more a year or as required by WAC 296-62-071; and

(3) All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and

(4) Members of HAZMAT teams.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30505, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30510 Frequency of medical examinations and consultations. Medical examinations and consultations shall be made available by the employer to each employee covered under WAC 296-62-3050 on the following schedules:

(1) For employees covered under WAC 296-62-30505 (1), (2), and (4):

(a) Prior to assignment;

(b) At least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

(c) At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months;

(d) As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits, or published exposure levels in an emergency situation;

(e) At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

(2) For employees covered under WAC 296-62-30505 who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

(a) As soon as possible following the emergency incident or development of signs or symptoms;

(b) At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30510, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30515 Content of medical examinations and consultations.

(1) Medical examinations required by WAC 296-62-30510 must include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the worksite.

(2) The content of medical examinations or consultations made available to employees under this section must be determined by the examining physician. The guidelines in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (See Appendix D, Reference #9) should be consulted.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30515, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30520 Examination by a physician and costs. All medical examinations and procedures must be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and must be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30520, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30525 Information provided to the physician. The employer must provide one copy of this standard and its appendices to the examining physician, and the following for each employee:

(1) A description of the employee's duties as they relate to the employee's exposures;

(2) The employee's exposure levels or anticipated exposure levels;

(3) A description of any personal protective equipment used or to be used;

(4) Information from previous medical examinations of the employee which is not readily available to the examining physician; and

(5) Information required in WAC 296-62-071 through 296-62-07121.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30525, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30530 Physician's written opinion.

(1) The employer must obtain and furnish the employee with a copy of a written opinion from the examining physician containing the following:

(a) The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response or from respirators use.

(b) The physician's recommended limitations upon the employees assigned work.

(c) The results of the medical examination and tests if requested by the employee.

(d) A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(2) The written opinion obtained by the employer must not reveal specific findings or diagnoses unrelated to occupational exposures.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30530, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30535 Recordkeeping of medical surveillance activities.

(1) An accurate record of the medical surveillance required by this section must be retained. This record must be retained for the period specified and meet the criteria of Part B of chapter 296-62 WAC.

(2) The record required in subsection (1) of this section must include at least the following information:

WAC 296-62-30535 (Cont.)

(a) The name and Social Security number of the employee;

(b) Physicians' written opinions, recommended limitations, and results of examinations and tests;

(c) Any employee medical complaints related to exposure to hazardous substances;

(d) A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30535, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3060 Engineering controls, work practices, and personal protective equipment for employee protection.

(1) Engineering controls, work practices, personal protective equipment, or a combination of these must be implemented in accordance with this section to protect employees from exposure to hazardous substances and health hazards.

(a) Engineering controls, work practices, and PPE for substances regulated in chapter 296-62 WAC.

Engineering controls and work practices must be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated by this chapter, except to the extent that such controls and practices are not feasible.

Note: Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all nonessential employees from potential exposure during opening of drums, wetting down dusty operations, and locating employees upwind of possible hazards.

(b) Whenever engineering controls and work practices are not feasible, or not required, any reasonable combination of engineering controls, work practices, and PPE must be used to reduce and maintain exposures to or below the permissible exposure limits or dose limits for substances regulated by chapter 296-62 WAC.

(c) The employer must not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(d) The provisions of WAC 296-62-080 through 296-62-09013, 296-62-09015 through 296-62-09055, and 296-62-100 through 296-62-130 must be followed.

(2) Engineering controls, work practices, and personal protective equipment for substances not regulated in chapter 296-62 WAC. An appropriate combination of engineering controls, work practices, and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated by chapter 296-62 WAC. The employer may use the published literature and MSDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure level.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3060, filed 03/23/99, effective 06/23/99.] Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-3060, filed 7/20/94, effective 9/20/94; 90-20-091 (Order 90-14), 296-62-3060, filed 10/1/90, effective 11/15/90; 89-21-018, 296-62-3060, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3060, filed 10/6/88, effective 11/7/88.]

WAC 296-62-30605 Personal protective equipment selection.

(1) Personal protective equipment (PPE) must be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(2) Personal protective equipment selection must be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

(3) Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply must be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(4) Totally encapsulating chemical protective suits (protection equivalent to Level A protection as recommended in Appendix B) must be used in conditions where skin absorbtion of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(5) The level of protection provided by PPE selection must be increased when additional information or site conditions indicate that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See WAC 296-62-3170 - Appendix B for guidance on selecting PPE ensembles.)

Note: The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in increased hazardous exposures to employees.

(6) Personal protective equipment must be selected and used to meet the requirements of WAC 296-800-160, and additional requirements specified in this part.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-30605, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30605, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30610 Totally encapsulating chemical protective suits.

(1) Totally encapsulating suits must protect employees from the particular hazards which are identified during site characterization and analysis.

(2) Totally encapsulating suits must be capable of maintaining positive air pressure. (See WAC 296-62-3160 - Appendix A for a test method which may be used to evaluate this requirement.)

(3) Totally encapsulating suits must be capable of preventing inward test gas leakage of more than 0.5 percent. (See WAC 296-62-3160 - Appendix A for a test method which may be used to evaluate this requirement.)

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30610, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30615 Personal protective equipment (PPE) program. A written personal protective equipment program, which is part of the employer's safety and health program required in WAC 296-62-3010 or 296-62-31405 and which must be part of the site-specific safety and health plan must be established. The PPE program must address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

(1) PPE selection based on site hazards;

(2) PPE use and limitations of the equipment;

(3) Work mission duration;

(4) PPE maintenance and storage;

WAC 296-62-30615 (Cont.)

(5) PPE decontamination and disposal;

(6) PPE training and proper fitting;

(7) PPE donning and doffing procedures;

(8) PPE inspection procedures prior to, during, and after use;

(9) Evaluation of the effectiveness of the PPE program; and

(10) Limitations during temperature extremes, heat stress, and other appropriate medical considerations.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30615, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3070 Monitoring concentrations of hazardous substances.

(1) Monitoring must be performed in accordance with this section where there may be a question of employee exposure to concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices, and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits or published exposure levels if there are no permissible exposure limits, for hazardous substances.

(2) Air monitoring must be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3070, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 90-20-091 (Order 90-14), 296-62-3070, filed 10/1/90, effective 11/15/90; 89-21-018, 296-62-3070, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3070, filed 10/6/88, effective 11/7/88.]

WAC 296-62-30705 Monitoring during initial entry. Upon initial entry, representative air monitoring must be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits, or other dangerous condition, such as the presence of flammable atmospheres or oxygen-deficient environments.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30705, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30710 Periodic monitoring. Periodic monitoring must be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it must be considered whether the possibility that exposures have risen are as follows:

(1) When work begins on a different portion of the site.

(2) When contaminants other than those previously identified are being handled.

(3) When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).

(4) When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

(5) When a sufficient reasonable interval has passed so that exposures may have significantly increased.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30710, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30715 Monitoring of high-risk employees. After the actual clean-up phase of any hazardous waste operation commences; for example, when soil, surface water, or containers are moved or disturbed; the employer must monitor those employees likely to have the highest exposures to hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently

WAC 296-62-30715 (Cont.)

enough to characterize employee exposures. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure levels, then monitoring must continue to determine all employees likely to be above those limits. The employer may use a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated in this subsection.

Note: It is not required to monitor employees engaged in site characterization operations covered by WAC 296-62-3020 through 296-62-30235.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30715, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3080 Informational programs. Employers must develop and implement a program which is part of the employer's safety and health program required in WAC 296-62-3010 through 296-62-30145 to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level, and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors, and subcontractors working outside of the operations part of a site are not covered by this standard.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3080, filed 03/23/99, effective 06/23/99.] Statutory Authority: Chapter 49.17 RCW. 89-21-018, 296-62-3080, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3080, filed 10/6/88, effective 11/7/88.]

WAC 296-62-3090 Handling drums and containers.

(1) Hazardous substances and contaminated soils, liquids, and other residues must be handled, transported, labeled, and disposed of in accordance with this section.

(2) Drums and containers used during the clean-up must meet the appropriate DOT, OSHA, WISHA, and EPA regulations for the wastes that they contain.

(3) When practical, drums and containers must be inspected and their integrity must be assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) must be moved to an accessible location and inspected prior to further handling.

(4) Unlabeled drums and containers must be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(5) Site operations must be organized to minimize the amount of drum or container movement.

(6) Prior to movement of drums or containers, all employees exposed to the transfer operation must be warned of the potential hazards associated with the contents of the drums or containers.

(7) United States Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent must be kept available and used in areas where spills, leaks, or ruptures may occur.

(8) Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in WAC 296-62-3010, must be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(9) Drums and containers that cannot be moved without rupture, leakage, or spillage must be emptied into a sound container using a device classified for the material being transferred.

(10) A ground-penetrating system or other type of detection system or device must be used to estimate the location and depth of buried drums or containers.

(11) Soil or covering material must be removed with caution to prevent drum or container rupture.

WAC 296-62-3090 (Cont.)

(12) Fire extinguishing equipment meeting the requirements of WAC 296-800-300 must be on hand and ready for use to control incipient fires.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-3090, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3090, filed 03/23/99, effective 06/23/99.] [Statutory Authority: Chapter 49.17 RCW. 93-19-142 (Order 93-04), 296-62-3090, filed 9/22/93, effective 11/1/93; 91-11-070 (Order 91-01), 296-62-3090, filed 5/20/91, effective 6/20/91; 89-21-018, 296-62-3090, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3090, filed 10/6/88, effective 11/7/88.]

WAC 296-62-30905 Opening drums and containers. The following procedures must be followed in areas where drums or containers are being opened:

(1) Where an airline respirator system is used, connections to the source of air supply must be protected from contamination and the entire system must be protected from physical damage.

(2) Employees not actually involved in opening drums or containers must be kept a safe distance from the drums or containers being opened.

(3) If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation must be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.

(4) Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment must be located behind the explosion-resistant barrier.

(5) When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools must be of the type to prevent sources of ignition.

(6) Drums and containers must be opened in such a manner that excess interior pressure will be safely relieved. If pressure cannot be relieved from a remote location, appropriate shielding must be placed between the employee and the drums or containers to reduce the risk of employee injury.

(7) Employees must not stand upon or work from drums or containers.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30905, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30910 Material handling equipment. Material handling equipment used to transfer drums and containers must be selected, positioned, and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30910, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30915 Radioactive wastes. Drums and containers containing radioactive wastes must not be handled until such time as their hazard to employees is properly assessed.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30915, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30920 Shock-sensitive wastes. As a minimum, the following special precautions must be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

(1) All nonessential employees must be evacuated from the area of transfer.

(2) Material handling equipment must be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

(3) An employee alarm system capable of being perceived above surrounding light and noise conditions must be used to signal the commencement and completion of explosive waste handling activities.

(4) Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) must be maintained between the employee-in-charge of the immediate handling area and the site safety and health supervisor and

command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock-sensitive materials to explode must not be used.

WAC 296-62-30920 (Cont.)

(5) Drums and containers under pressure, as evidenced by bulging or swelling, must not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

(6) Drums and containers containing packaged laboratory wastes must be considered to contain shock-sensitive or explosive materials until they have been characterized.

Caution: *Shipping of shock-sensitive wastes may be prohibited under United States Department of Transportation regulations. Employers and their shippers should refer to WAC 480-12-195*.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30920, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30925 Laboratory waste packs. In addition to the requirements of WAC 296-62-30915, the following precautions must be taken, as a minimum, in handling laboratory waste packs (lab packs):

(1) Lab packs must be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.

(2) If crystalline material is noted on any container, the contents must be handled as a shock-sensitive waste until the contents are identified.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30925, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30930 Sampling of drum and container contents. Sampling of containers and drums must be done in accordance with a sampling procedure which is part of the site safety and health plan developed for and available to employees and others at the specific worksite.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30930, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30935 Shipping and transport of drums.

(1) Drums and containers must be identified and classified prior to packaging for shipment.

(2) Drum or container staging areas must be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

(3) Staging areas must be provided with adequate access and egress routes.

(4) Bulking of hazardous wastes must be permitted only after a thorough characterization of the materials has been completed.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30935, filed 03/23/99, effective 06/23/99.]

WAC 296-62-30940 Tanks and vaults procedures.

(1) Tanks and vaults containing hazardous substances must be handled in a manner similar to that for drums and containers, taking into consideration the size of the tank or vault.

(2) Appropriate tank or vault entry procedures as described in chapter 296-62 WAC, Part M and the employer's safety and health plan must be followed whenever employees must enter a tank or vault.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-30940, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3100 Decontamination procedures.

(1) **General.** Procedures for all phases of decontamination must be developed according to WAC 296-62-3100 through 296-62-31015.

(2) **Decontamination procedures.**

WAC 296-62-3100 (Cont.)

(a) A decontamination procedure must be developed, communicated to employees and implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

(b) Standard operating procedures must be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(c) All employees leaving a contaminated area must be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area must be appropriately disposed of or decontaminated.

(d) Decontamination procedures must be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps must be taken to correct any deficiencies.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3100, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 89-21-018, 296-62-3100, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3100, filed 10/6/88, effective 11/7/88.]

WAC 296-62-31005 Location of decontamination areas. Decontamination must be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31005, filed 03/23/99, effective 06/23/99.]

WAC 296-62-31010 Decontamination of equipment and solvents. All equipment and solvents used for decontamination must be decontaminated or disposed of properly.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31010, filed 03/23/99, effective 06/23/99.]

WAC 296-62-31015 Decontamination of personal protective clothing and equipment.

(1) Protective clothing and equipment must be decontaminated, cleaned, laundered, maintained, or replaced as needed to maintain their effectiveness.

(2) Employees whose nonimpermeable clothing becomes wetted with hazardous substances must immediately remove that clothing and proceed to shower. The clothing must be disposed of or decontaminated before it is removed from the work zone.

(3) Unauthorized employees. Unauthorized employees must not remove protective clothing or equipment from change rooms.

(4) Commercial laundries or cleaning establishments. Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment must be informed of the potentially harmful effects of exposures to hazardous substances.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31015, filed 03/23/99, effective 06/23/99.]

WAC 296-62-31020 Showers and change rooms used for decontamination. Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they must be provided and meet the requirements of Part B-1 of chapter 296-24 WAC. If temperature conditions prevent the effective use of water, then other effective means for cleansing must be provided and used.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31020, filed 03/23/99, effective 06/23/99.]

WAC 296-62-3110 Emergency response by employees at uncontrolled hazardous waste sites.

(1) An emergency response plan must be developed and implemented by all employers within the scope of WAC 296-62-30001 (1)(a) and (b) to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan must be in writing and available for inspection and copying by

employees, their representatives, WISHA personnel, and other governmental agencies with relevant responsibilities.

WAC 296-62-3110 (Cont.)

(2) Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of this section if they provide an emergency action plan complying with WAC 296-24-567(1).

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3110, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 90-20-091 (Order 90-14), 296-62-3110, filed 10/1/90, effective 11/15/90; 90-09-026 (Order 90-01), 296-62-3110, filed 4/10/90, effective 5/25/90; 89-21-018 (Order 89-10), 296-62-3110, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3110, filed 10/6/88, effective 11/7/88.]

WAC 296-62-31105 Elements of an emergency response plan at uncontrolled hazardous waste sites.

The employer must develop an emergency response plan for emergencies which must address as a minimum, the following:

(1) Preemergency planning.

(2) Personnel roles, lines of authority, and communication.

(3) Emergency recognition and prevention.

(4) Safe distances and places of refuge.

(5) Site security and control.

(6) Evacuation routes and procedures.

(7) Decontamination procedures which are not covered by the site safety and health plan.

(8) Emergency medical treatment and first aid.

(9) Emergency alerting and response procedures.

(10) Critique of response and follow-up.

(11) PPE and emergency equipment.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31105, filed 03/23/99, effective 06/23/99.]

WAC 296-62-31110 Procedures for handling emergency incidents at uncontrolled hazardous waste sites.

(1) In addition to the elements for the emergency response plan required in WAC 296-62-31105, the following elements must be included for emergency response plans:

(a) Site topography, layout, and prevailing weather conditions.

(b) Procedures for reporting incidents to local, state, and federal governmental agencies.

(2) The emergency response plan must be a separate section of the site safety and health plan.

(3) The emergency response plan must be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(4) The emergency response plan must be rehearsed regularly as part of the overall training program for site operations.

WAC 296-62-31110 (Cont.)

(5) The site emergency response plan must be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(6) An employee alarm system must be installed in accordance with WAC 296-24-631 through 296-24-63199 to notify employees of an on-site emergency situation, to stop work activities if necessary, to lower background noise in order to speed communication, and to begin emergency procedures.

(7) Based upon the information available at the time of the emergency, the employer must evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the on-site emergency response plan.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31110, filed 03/23/99, effective 06/23/99.

WAC 296-62-3120 Illumination. Areas accessible to employees must be lighted to not less than the minimum illumination intensities listed in Table 1 while any work is in progress:

TABLE 1 - 120.1--MINIMUM ILLUMINATION
Intensities in Foot-Candles

Foot-Candles	Area of Operation
5	General site area.
3	Excavation and waste areas, accessways , active storage areas, loading platforms, refueling and field maintenance areas.
5	Indoors: Warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas; exception: Minimum of ten foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Mine Safety and Health Administration and the National Institute for Occupational Safety and Health approved cap lights shall be acceptable for use in the tunnel heading.
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms).
30	First aid stations, infirmaries, and offices.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3120, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-3120, filed 7/20/94, effective 9/20/94; 89-21-018, 296-62-3120, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3120, filed 10/6/88, effective 11/7/88.]

WAC 296-62-3130 Sanitation at temporary workplaces.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3130, filed 03/23/99, effective 06/23/99.

WAC 296-62-31305 Potable water.

(1) An adequate supply of potable water must be provided on the site.

(2) Portable containers used to dispense drinking water must be capable of being tightly closed, and equipped with a tap. Water must not be dipped from containers.

(3) Any container used to distribute drinking water must be clearly marked as to the nature of its contents and not used for any other purpose.

(4) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups must be provided.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31305, filed 03/23/99, effective 06/23/99.

WAC 296-62-31310 Nonpotable water.

(1) Outlets for nonpotable water, such as water for fire fighting purposes must be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(2) There must be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31310, filed 03/23/99, effective 06/23/99.

WAC 296-62-31315 Toilet facilities.

(1) Toilets must be provided for employees according to Table 2.

TABLE 2--TOILET FACILITIES

Number of Employees	Minimum Number of Facilities
20 or fewer	One.
More than 20, fewer than 200	One toilet seat and one urinal per 40 employees.
More than 200	One toilet seat and one urinal per 50 employees.

(2) Under temporary field conditions, provisions must be made to assure that at least one toilet facility is available.

(3) Hazardous waste sites, not provided with a sanitary sewer must be provided with the following toilet facilities unless prohibited by local codes:

(a) Chemical toilets;

(b) Recirculating toilets;

(c) Combustion toilets; or

(d) Flush toilets.

(4) The requirements for this section for sanitation facilities must not apply to mobile crews having transportation readily available to nearby toilet facilities.

(5) Doors entering toilet facilities must be provided with entrance locks controlled from inside the facility.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31315, filed 03/23/99, effective 06/23/99.

WAC 296-62-31320 Food handling. All food service facilities and operations for employees must meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31320, filed 03/23/99, effective 06/23/99.

WAC 296-62-31325 Temporary sleeping quarters. When temporary sleeping quarters are provided, they must be heated, ventilated, and lighted.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31325, filed 03/23/99, effective 06/23/99.

WAC 296-62-31330 Washing facilities. The employer must provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities must be in near proximity to the worksite, in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer, and must be so equipped as to enable employees to remove hazardous substances from themselves.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31330, filed 03/23/99, effective 06/23/99.

WAC 296-62-31335 Showers and change rooms. When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer must provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

(1) Showers must be provided and must meet the requirements of WAC 296-24-12010(2) Change rooms must be provided and must meet the requirements of WAC 296-24-12011. Change rooms must consist of two separate change areas separated by the shower area required in (1) of this subsection. One change area, with an exit leading off the worksite, must provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, must provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

(2) Showers and change rooms must be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system must be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(3) Employers must assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31335, filed 03/23/99, effective 06/23/99.

WAC 296-62-3138 New technology programs.

(1) The employer must develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same must be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(2) New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminants while excavating the site or for spill control, must be evaluated by employers or their representatives. Such an evaluation must be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations must be made available to WISHA upon request.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3138, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 89-21-018, 296-62-3138, filed 10/10/89, effective 11/24/89.]

WAC 296-62-3140 Certain operations conducted under the Resource Conservation and Recovery Act of 1976 (RCRA). Employers conducting operations at treatment, storage, and disposal (TSD) facilities specified in WAC 296-62-30001 (1)(d) must provide and implement the programs specified in WAC 296-62-3140 through 296-62-31470. See the "Notes and Exceptions" of WAC 296-62-30001 (2)(c) for employers not covered.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3140, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 94-16-145, 296-62-3140, filed 8/3/94, effective 9/12/94; 91-24-017 (Order 91-07), 296-62-3140, filed 11/22/91, effective 12/24/91; 90-20-091 (Order 90-14), 296-62-3140, filed 10/1/90, effective 11/15/90; 89-21-018, 296-62-3140, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3140, filed 10/6/88, effective 11/7/88.]

WAC 296-62-31405 Safety and health program under RCRA. The employer must develop and implement a written safety and health program for employees involved in hazardous waste operations that must be available for inspection by employees, their representatives and WISHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of WAC 296-62-3110 and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31405, filed 03/23/99, effective 06/23/99.

WAC 296-62-31410 Hazard communication program requirements under RCRA. The employer must implement a hazard communication program meeting the requirements of WAC 296-800-170, as part of the employer's safety and health program.

WAC 296-62-31410 (Cont.)

Note: The exemption for hazardous waste provided in WAC 296-800-170 is applicable to this section.
[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-31410, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31410, filed 03/23/99, effective 06/23/99.]

WAC 296-62-31415 Medical surveillance program requirements under RCRA. The employer must develop and implement a medical surveillance program meeting the requirements of WAC 296-62-3050.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31415, filed 03/23/99, effective 06/23/99.

WAC 296-62-31420 Decontamination program requirements under RCRA. The employer must develop and implement a decontamination procedure meeting the requirements of WAC 296-62-3100 through 296-62-31015.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31420, filed 03/23/99, effective 06/23/99.

WAC 296-62-31425 New technology programs requirements under RCRA. The employer must develop and implement procedures meeting the requirements of WAC 296-62-3138 for introducing new and innovative equipment into the workplace.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31425, filed 03/23/99, effective 06/23/99.

WAC 296-62-31430 Material handling program requirements under RCRA. Where employees will be handling drums or containers, the employer must develop and implement procedures meeting the requirements of WAC 296-62-3090 (2) through (8), as well as WAC 296-62-30910 and 296-62-30935, prior to starting such work.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31430, filed 03/23/99, effective 06/23/99.

WAC296-62-31435 Training program for new employees under RCRA. The employer must develop and implement a training program, which is part of the employer's safety and health program, for employees exposed to health hazards or hazardous substances at TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not to endanger themselves or other employees. The initial training must be for 24 hours and refresher training must be for eight hours annually. Employees who have received the initial training required by this section shall be given a written certificate attesting that they have successfully completed the necessary training.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31435, filed 03/23/99, effective 06/23/99.

WAC 296-62-31440 Training program for current employees. Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this section, must be considered as meeting the initial training requirements of this section as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees must receive eight hours of refresher training annually.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31440, filed 03/23/99, effective 06/23/99.

WAC 296-62-31445 RCRA requirements for trainers. Trainers who teach initial training must have satisfactorily completed a training course for teaching the subjects they are expected to teach or they must have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31445, filed 03/23/99, effective 06/23/99.

WAC 296-62-31450 Emergency response program requirements under RCRA.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31450, filed 03/23/99, effective 06/23/99.

WAC 296-62-31455 Emergency response plan under RCRA. An emergency response plan must be developed and implemented by all employers. The plan does not need to duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the United States Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan must be a written portion of the employer's safety and health program. Employers who will evacuate their employees from the worksite location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of WAC 296-62-31450 through 296-62-31470 if they provide an emergency action plan meeting the requirements in WAC 296-24-567.
[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31455, filed 03/23/99, effective 06/23/99.

WAC 296-62-31460 Elements of an emergency response plan under RCRA. The employer must develop an emergency response plan for emergencies. The plan must address the following areas to the extent that they are not addressed in any specific program required in this part:

(1) Preemergency planning and coordination with outside parties.

(2) Personnel roles, lines of authority, and communication.

(3) Emergency recognition and prevention.

(4) Safe distances and places of refuge.

(5) Site security and control.

(6) Evacuation routes and procedures.

(7) Decontamination procedures.

(8) Emergency medical treatment and first aid.

(9) Emergency alerting and response procedures.

(10) Critique of response and follow-up.

(11) PPE and emergency equipment.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31460, filed 03/23/99, effective 06/23/99.

WAC 296-62-31465 Training requirements for emergency response under RCRA.

(1) Training for emergency response employees must be completed before they are called upon to perform in real emergencies. The training must cover the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn, and procedures for handling emergency incidents.

Exception #1: *An employer need not train all employees to the degree specified if the employer divides the workforce in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt to control activities for which they are not trained.*

Exception #2: *An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully trained emergency response team for assistance.*

(2) Employee members of TSD facility emergency response organizations must be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to overexposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from overexposures.

WAC 296-62-31465 (Cont.)

(3) The employer must certify that each covered employee has attended and successfully completed the training required in this subsection, or must certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training must be recorded and maintained by the employer.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31465, filed 03/23/99, effective 06/23/99.

WAC 296-62-31470 Procedures for handling emergency incidents under RCRA.

(1) In addition to the elements for the emergency response plan required in WAC 296-62-31460, the following elements must be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(a) Site topography, layout, and prevailing weather conditions.

(b) Procedures for reporting incidents to local, state, and federal governmental agencies.

(2) The emergency response plan must be compatible and integrated with the disaster, fire, and/or emergency response plans of local, state, and federal agencies.

(3) The emergency response plan must be rehearsed regularly as part of the overall training program for site operations.

(4) The site emergency response plan must be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(5) An employee alarm system must be installed in accordance with WAC 296-24-631 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(6) Based upon the information available at time of the emergency, the employer must evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-31470, filed 03/23/99, effective 06/23/99.

WAC 296-62-3152 Appendices to Part P--Hazardous waste operations and TSD facilities.

Note: The following appendices serve as nonmandatory guidelines to assist employees and employers in complying with the appropriate requirements of this part. However, WAC 296-62-3060 through 296-62-30615 makes mandatory in certain circumstances the use of Level A and Level B personal protective equipment protection.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3152, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 89-21-018, 296-62-3152, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3152, filed 10/6/88, effective 11/7/88.]

WAC 296-62-3160 Appendix A--Personal protective equipment test methods. This appendix sets forth the nonmandatory examples of tests which may be used to evaluate compliance with WAC 296-62-3060. Other tests and other challenge agents may be used to evaluate compliance.

(1) **Totally-encapsulating chemical protective suit pressure test.**

(a) Scope.

(i) This practice measures the ability of a gas tight totally-encapsulating chemical protective suit material, seams, and closures to maintain a fixed positive pressure. The results of this practice allow the gas tight integrity of a total-encapsulating chemical protective suit to be evaluated.

WAC 296-62-3160 (Cont.)

(ii) Resistance of the suit materials to permeation, penetration, and degradation by specific hazardous substances is not determined by this test method.

(b) Definition of terms.

(i) **"Totally-encapsulated chemical protective suit (TECP suit)"** means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, and legs; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

(ii) **"Protective clothing material"** means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

(iii) **"Gas tight"** means for the purpose of this test method the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

(c) Summary of test method. The TECP suit is visually inspected and modified for the test. The test apparatus is attached to the suit to permit inflation to the pretest suit expansion pressure for removal of suit wrinkles and creases. The pressure is lowered to the test pressure and monitored for three minutes. If the pressure drop is excessive, the TECP suit fails the test and is removed from service. The test is repeated after leak location and repair.

(d) Required supplies.

(i) Source of compressed air.

(ii) Test apparatus for suit testing including a pressure measurement device with a sensitivity of at least 1/4 inch water gauge.

(iii) Vent valve closure plugs or sealing tape.

(iv) Soapy water solution and soft brush.

(v) Stopwatch or appropriate timing device.

(e) Safety precautions. Care must be taken to provide the correct pressure safety devices required for the source of compressed air used.

(f) Test procedure. Prior to each test, the tester must perform a visual inspection of the suit. Check the suit for seam integrity by visually examining the seams and gently pulling on the seams. Ensure that all air supply lines, fittings, visor, zippers, and valves are secure and show no signs of deterioration.

(i) Seal off the vent valves along with any other normal inlet or exhaust points (such as umbilical air line fittings or facepiece opening) with tape or other appropriate means (caps, plugs, fixture, etc.). Care should be exercised in the sealing process not to damage any of the suit components.

(ii) Close all closure assemblies.

WAC 296-62-3160 (Cont.)

(iii) Prepare the suit for inflation by providing an improvised connection point on the suit for connecting an airline. Attach the pressure test apparatus to the suit to permit suit inflation from a compressed air source equipped with a pressure indicating regulator. The leak tightness of the pressure test apparatus should be tested before and after each test by closing off the end of the tubing attached to the suit and assuring a pressure of three inches water gauge for three minutes can be maintained. If a component is removed for the test, that component must be replaced and a second test conducted with another component removed to permit a complete test of the ensemble.

(iv) The pretest expansion pressure (A) and the suit test pressure (B) must be supplied by the suit manufacturer, but in no case shall they be less than (A) = 3 inches water gauge and (B) = 2 inches water gauge. The ending suit pressure (C) must be no less than eighty percent of the test pressure (B); i.e., the pressure drop must not exceed twenty percent of the test pressure (B).

(v) Inflate the suit until the pressure inside is equal to pressure (A), the pretest expansion suit pressure. Allow at least one minute to fill out the wrinkles in the suit. Release sufficient air to reduce the suit pressure to pressure (B), the suit test pressure. Begin timing. At the end of three minutes, record the suit pressure as pressure (C), the ending suit pressure. The difference between the suit test pressure and the ending suit test pressure (B)-(C) must be defined as the suit pressure drop.

(vi) If the suit pressure drop is more than twenty percent of the suit test pressure (B) during the three minute test period, the suit fails the test and must be removed from service.

(g) Retest procedure.

(i) If the suit fails the test check for leaks by inflating the suit to pressure (A) and brushing or wiping the entire suit (including seams, closures, lens gaskets, glove-to-sleeve joints, etc.) with a mild soap and water solution. Observe the suit for the formation of soap bubbles, which is an indication of a leak. Repair all identified leaks.

(ii) Retest the TECP suit as outlined in (f) of this subsection.

(h) Report. Each TECP suit tested by this practice must have the following information recorded.

(i) Unique identification number, identifying brand name, date of purchase, material of construction, and unique fit features; e.g., special breathing apparatus.

(ii) The actual values for test pressures (A), (B), and (C) must be recorded along with the specific observation times. If the ending pressure (C) is less than eighty percent of the test pressure (B), the suit must be identified as failing the test. When possible, the specific leak location must be identified in the test records. Retest pressure data must be recorded as an additional test.

(iii) The source of the test apparatus used must be identified and the sensitivity of the pressure gauge must be recorded.

(iv) Records must be kept for each pressure test even if repairs are being made at the test location.

Caution. *Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust*

valve to make sure it is not blocked. Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

WAC 296-62-3160 (Cont.)

(2) **Totally-encapsulating chemical protective suit qualitative leak test.**

(a) Scope.

(i) This practice semiqualitatively tests gas tight totally-encapsulating chemical protective suit integrity by detecting inward leakage of ammonia vapor. Since no modifications are made to the suit to carry out this test, the results from this practice provide a realistic test for the integrity of the entire suit.

(ii) Resistance of the suit materials to permeation, penetration, and degradation is not determined by this test method. ASTM test methods are available to test suit materials for those characteristics and the tests are usually conducted by the manufacturers of the suits.

(b) Definition of terms.

(i) **"Totally-encapsulated chemical protective suit (TECP suit)"** means a full body garment which is constructed of protective clothing materials; covers the wearer's torso, head, arms, and legs; may cover the wearer's hands and feet with tightly attached gloves and boots; completely encloses the wearer and respirator by itself or in combination with the wearer's gloves and boots.

(ii) **"Protective clothing material"** means any material or combination of materials used in an item of clothing for the purpose of isolating parts of the body from direct contact with a potentially hazardous liquid or gaseous chemicals.

(iii) **"Gas tight"** means for the purpose of this test method the limited flow of a gas under pressure from the inside of a TECP suit to atmosphere at a prescribed pressure and time interval.

(iv) **"Intrusion coefficient."** A number expressing the level of protection provided by a gas tight totally-encapsulating chemical protective suit. The intrusion coefficient is calculated by dividing the test room challenge agent concentration by the concentration of challenge agent found inside the suit. The accuracy of the intrusion coefficient is dependent on the challenge agent monitoring methods. The larger the intrusion coefficient, the greater the protection provided by the TECP suit.

(c) Summary of recommended practice. The volume of concentrated aqueous ammonia solution (ammonia hydroxide, NH4 OH) required to generate the test atmosphere is determined using the directions outlined in WAC 296-62-3160 (2)(f)(i). The suit is donned by a person wearing the appropriate respiratory equipment (either a positive pressure self-contained breathing apparatus or a supplied air respirator) and worn inside the enclosed test room. The concentrated aqueous ammonia solution is taken by the suited individual into the test room and poured into an open plastic pan. A two-minute evaporation period is observed before the test room concentration is measured using a high range ammonia length of stain detector tube. When the ammonia reaches a concentration of between 1000 and 1200 ppm, the suited individual starts a standardized exercise protocol to stress and flex the suit. After this protocol is completed the test room concentration is measured again.

The suited individual exits the test room and his stand-by person measures the ammonia concentration inside the suit using a low range ammonia length of stain detector tube or other more sensitive ammonia detector. A stand-by person is required to observe the test individual during the test procedure, aid the person in donning and doffing the TECP suit and monitor the suit interior. The intrusion coefficient of the suit can be calculated by dividing the average test

WAC 296-62-3160 (Cont.)

area concentration by the interior suit concentration. A colorimetric indicator strip of bromophenol blue is placed on the inside of the suit facepiece lens so that the suited individual is able to detect a color change and know if the suit has a significant leak. If a color change is observed the individual should leave the test room immediately.

(d) Required supplies.

(i) A supply of concentrated aqueous ammonium hydroxide, 58% by weight.

(ii) A supply of bromophenol/blue indicating paper, sensitive to 5-10 ppm ammonia or greater over a two-minute period of exposure [pH 3.0 (yellow) to pH 4.6 (blue)].

(iii) A supply of high range (0.5-10 volume percent) and low range (5-700 ppm) detector tubes for ammonia and the corresponding sampling pump. More sensitive ammonia detectors can be substituted for the low range detector tubes to improve the sensitivity of this practice.

(iv) A shallow plastic pan (PVC) at least 12":14":1" and a half pint plastic container (PVC) with tightly closing lid.

(v) A graduated cylinder or other volumetric measuring device of at least fifty milliliters in volume with an accuracy of at least ± 1 milliliters.

(e) Safety precautions.

(i) Concentrated aqueous ammonium hydroxide, NH4OH is a corrosive volatile liquid requiring eye, skin, and respiratory protection. The person conducting the test must review the MSDS for aqueous ammonia.

(ii) Since the established permissible exposure limit for ammonia is 35 ppm as a 15 minute STEL, only persons wearing a positive pressure self-contained breathing apparatus or a supplied air respirator must be in the chamber. Normally only the person wearing the total-encapsulating suit will be inside the chamber. A stand-by person must have a self-contained breathing apparatus, or a positive pressure supplied air respirator available to enter the test area should the suited individual need assistance.

(iii) A method to monitor the suited individual must be used during this test. Visual contact is the simplest but other methods using communication devices are acceptable.

(iv) The test room must be large enough to allow the exercise protocol to be carried out and then to be ventilated to allow for easy exhaust of the ammonia test atmosphere after the test(s) are completed.

(v) Individuals must be medically screened for the use of respiratory protection and checked for allergies to ammonia before participating in this test procedure.

(f) Test procedure.

(i) Measure the test area to the nearest foot and calculate its volume in cubic feet. Multiply the test area volume by 0.2 milliliters of concentrated aqueous ammonia per cubic foot of test area volume to determine the approximate volume of concentrated aqueous ammonia required to generate 1000 ppm in the test area.

(A) Measure this volume from the supply of concentrated ammonia and place it into a closed plastic container.

WAC 296-62-3160 (Cont.)

(B) Place the container, several high range ammonia detector tubes and the pump in the clean test pan and locate it near the test area entry door so that the suited individual has easy access to these supplies.

(ii) In a noncontaminated atmosphere, open a presealed ammonia indicator strip and fasten one end of the strip to the inside of the suit face shield lens where it can be seen by the wearer. Moisten the indicator strip with distilled water. Care must be taken not to contaminate the detector part of the indicator paper by touching it. A small piece of masking tape or equivalent should be used to attach the indicator strip to the interior of the suit face shield.

(iii) If problems are encountered with this method of attachment the indicator strip can be attached to the outside of the respirator facepiece being used during the test.

(iv) Don the respiratory protective device normally used with the suit, and then don the TECP suit to be tested. Check to be sure all openings which are intended to be sealed (zippers, gloves, etc.) are completely sealed. do not, however, plug off any venting valves.

(v) Step into the enclosed test room such as a closet, bathroom, or test booth, equipped with an exhaust fan. No air should be exhausted from the chamber during the test because this will dilute the ammonia challenge concentrations.

(vi) Open the container with the premeasured volume of concentrated aqueous ammonia within the enclosed test room, and pour the liquid into the empty plastic test pan. Wait two minutes to allow for adequate volatilization of the concentrated aqueous ammonia. A small mixing fan can be used near the evaporation pan to increase the evaporation rate of the ammonia solution.

(vii) After two minutes a determination of the ammonia concentration within the chamber should be made using the high range colorimetric detector tube. A concentration of 1000 ppm ammonia or greater must be generated before the exercises are started.

(viii) To test the integrity of the suit the following four minute exercise protocol should be followed:

(A) Raising the arms above the head with at least fifteen raising motions completed in one minute.

(B) Walking in place for one minute with at least fifteen raising motions of each leg in a one-minute period.

(C) Touching the toes with at least ten complete motions of the arms from above the head to touching of the toes in a one-minute period.

(D) Knee bends with at least ten complete standing and squatting motions in a one-minute period.

(ix) If at any time during the test the colorimetric indicating paper should change colors the test should be stopped and (f)(x) and (xi) of this subsection initiated.

(x) After completion of the test exercise, the test area concentration should be measured again using the high range colorimetric detector tube.

(xi) Exit the test area.

WAC 296-62-3160 (Cont.)

(xii) The opening created by the suit zipper or other appropriate suit penetration should be used to determine the ammonia concentration in the suit with the low range length of stain detector tube or other ammonia monitor. The internal TECP suit air should be sampled far enough from the enclosed test area to prevent a false ammonia reading.

(xiii) After completion of the measurement of the suit interior ammonia concentration the test is concluded and the suit is doffed and the respirator removed.

(xiv) The ventilating fan for the test room should be turned on and allowed to run for enough time to remove the ammonia gas. The fan must be vented to the outside of the building.

(xv) Any detectable ammonia in the suit interior (5 ppm ammonia (NH_3) or more for the length of stain detector tube) indicates the suit failed the test. When other ammonia detectors are used, a lower level of detection is possible and it should be specified as the pass/fail criteria.

(xvi) By following this test method an intrusion coefficient of approximately two hundred or more can be measured with the suit in a completely operational condition. If the intrusion coefficient is 200 or more, then the suit is suitable for emergency response and field use.

(g) Retest procedures.

(i) If the suit fails this test, check for leaks by following the pressure test in test (A) above.

(ii) Retest the TECP suit as outlined in the test procedure in (f) of this subsection.

(h) Report.

(i) Each gas tight totally-encapsulating chemical protective suit tested by this practice must have the following information recorded.

(A) Unique identification number, identifying brand name, date of purchase, material of construction, and unique suit features; e.g., special breathing apparatus.

(B) General description of test room used for test.

(C) Brand name and purchase date of ammonia detector strips and color change data.

(D) Brand name, sampling range, and expiration date of the length of stain ammonia detector tubes. The brand name and model of the sampling pump should also be recorded. If another type of ammonia detector is used, it should be identified along with its minimum detection limit for ammonia.

(E) Actual test results must list the two test area concentrations, their average, the interior suit concentration, and the calculated intrusion coefficient. Retest data must be recorded as an additional test.

(ii) The evaluation of the data must be specified as “suit passed” or “suit failed” and the date of the test. Any detectable ammonia (5 ppm or greater for the length of stain detector tube) in the suit interior indicates the suit fails this test. When other ammonia detectors

are used, a lower level of detection is possible and it should be specified as the pass/fail criteria.

WAC 296-62-3160 (Cont.)

Caution. *Visually inspect all parts of the suit to be sure they are positioned correctly and secured tightly before putting the suit back into service. Special care should be taken to examine each exhaust valve to make sure it is not blocked.*

Care should also be exercised to assure that the inside and outside of the suit is completely dry before it is put into storage.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3160, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 91-24-017 (Order 91-07), 296-62-3160, filed 11/22/91, effective 12/24/91; 90-20-091 (Order 90-14), 296-62-3160, filed 10/1/90, effective 11/15/90; 89-21-018, 296-62-3160, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3160, filed 10/6/88, effective 11/7/88.]

WAC 296-62-3170 Appendix B--General description and discussion of the levels of protection and protective gear.

(1) This appendix sets forth information about personal protective equipment (PPE) protection levels which may be used to assist employers in complying with the PPE requirements of this section.

(2) As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

(3) Selection of the appropriate PPE is a complex process which must take into consideration a variety of factors. Key factors involved in this process are identification of the hazards or suspected hazards, their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact), and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work durations.

(4) Other factors in this selection process to be considered are matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, must be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits or equipment.

(5) The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the site supervisor can make decisions to up-grade or down-grade the level of PPE protection to match the tasks at hand.

(6) The following are guidelines which an employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the use of combinations of PPE selected from the different protection levels (i.e., A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and reselection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

(7) Personal protective equipment has been divided into four categories based on the degree of protection afforded (see subsection (8) of this section for further explanation of Levels A, B, C, and D hazards):

(a) Level A. To be selected when the greatest level of skin, respiratory, and eye protection is required. The following constitute Level A equipment; it may be used as appropriate:

(i) Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied-air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).

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(ii) Totally-encapsulating chemical-protective suit.

(iii) Coveralls.*

(iv) Long underwear.*

(v) Gloves, outer, chemical-resistant.

(vi) Gloves, inner, chemical-resistant.

(vii) Boots, chemical-resistant steel toe and shank.

(viii) Hard hat (under suit).*

(ix) Disposable protective suit, gloves, and boots. (Depending on suit construction, may be worn over totally-encapsulating suit.)

*Optional, as applicable.

(b) Level B. The highest level of respiratory protection is necessary but a lesser level of skin protection is needed. The following constitute Level B equipment; it may be used as appropriate:

(i) Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied-air respirator with escape SCBA (NIOSH approved).

(ii) Hooded chemical-resistant clothing (overalls and long-sleeved jacket, coveralls, one or two-piece chemical-splash suit, disposable chemical-resistant overalls).

(iii) Coveralls.*

(iv) Gloves, outer, chemical-resistant.

(v) Gloves, inner, chemical-resistant.

(vi) Boots, outer, chemical-resistant steel toe and shank.

(vii) Boot-covers, outer, chemical-resistant (disposable).*

(viii) Hard hat.

(ix) Face shield.*

*Optional, as applicable.

(c) Level C. The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met. The following constitute Level C equipment; it may be used as appropriate.

(i) Full-face or half-mask, air purifying respirators (NIOSH approved).

(ii) Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).

(iii) Coveralls.*

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(iv) Gloves, outer, chemical-resistant.

(v) Gloves, inner, chemical-resistant.

(vi) Boots (outer), chemical-resistant steel toe and shank.*

(vii) Boot-covers, outer, chemical-resistant (disposable).*

(viii) Hard hat.

(ix) Escape mask.*

(x) Face shield.*

Optional, as applicable.

(d) Level D. A work uniform affording minimal protection: Used for nuisance contamination only. The following constitute Level D equipment; it may be used as appropriate.

(i) Coveralls.

(ii) Gloves.*

(iii) Boots/shoes, chemical-resistant steel toe and shank.

(iv) Boots, outer, chemical-resistant (disposable).*

(v) Safety glasses or chemical splash goggles.*

(vi) Hard hat.

(vii) Escape mask.*

(viii) Face shield.*

Optional, as applicable.

(8) Part B. The types of hazards for which Levels A, B, C, and D protection are appropriate are described below:

(a) Level A - Level A protection should be used when:

(i) The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the intact skin;

(ii) Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or

(iii) Operations are being conducted in confined, poorly ventilated areas, and the absence of conditions requiring Level A have not yet been determined.

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(b) Level B protection should be used when:

(i) The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection;

(ii) The atmosphere contains less than 19.5 percent oxygen; or

(iii) The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

(c) Level C protection should be used when:

(i) The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin;

(ii) The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

(iii) All criteria for the use of air-purifying respirators are met.

(d) Level D protection should be used when:

(i) The atmosphere contains no known hazard; and

(ii) Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Note: As stated before combinations of personal protective equipment other than those described for Levels A, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

(9) As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association (NFPA) has developed standards on chemical protective clothing. The standards that have been adopted include:

(a) NFPA 1991 - Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing);

(b) NFPA 1992 - Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing);

(c) NFPA 1993 - Standard on Liquid Splash-Protective Suits for Nonemergency, Nonflammable Hazardous Chemical Situations (EPA Level B Protective Clothing).

(10) These standards apply documentation and performance requirements to the manufacture of chemical protective suits. Chemical protective suits meeting these requirements are labelled as compliant with the appropriate standard. It is recommended that chemical protective suits that meet these standards be used.

[Statutory Authority: Chapter 49.17 RCW. 95-04-006, 296-62-3170, filed 1/18/95, effective 3/10/95; 90-20-091 (Order 90-14), 296-62-3170, filed 10/1/90, effective 11/15/90; 89-21-018, 296-62-3170, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3170, filed 10/6/88, effective 11/7/88.]

WAC 296-62-3180 Appendix C--Compliance guidelines.

(1) Occupational safety and health program. Each hazardous waste site clean-up effort will require an occupational safety and health program headed by the site coordinator or the employer's representative. The purpose of the program will be the protection of employees at the site and will be an extension of the employer's overall safety and health program. The program will need to be developed before work begins on the site and implemented as work proceeds as stated in WAC 296-62-3010 through 296-62-30145. The program is to facilitate coordination and communication of safety and health issues among personnel responsible for the various activities which will take place at the site. It will provide the overall means for planning and implementing the needed safety and health training and job orientation of employees who will be working at the site. The program will provide the means for identifying and controlling worksite hazards and the means for monitoring program effectiveness. The program will need to cover the responsibilities and authority of the site coordinator or the employer's manager on the site for the safety and health of employees at the site, and the relationships with contractors or support services as to what each employer's safety and health responsibilities are for their employees on the site. Each contractor on the site needs to have its own safety and health program so structured that it will smoothly interface with the program of the site coordinator or principal contractor. Also those employers involved with treating, storing, or disposal of hazardous waste as covered in WAC 296-62-3140 must have implemented a safety and health plan for their employees. This program is to include the hazard communication program required in WAC 296-62-31405 and the training required in WAC 296-62-31420 and 296-62-31425 as parts of the employers comprehensive overall safety and health program. This program is to be in writing.

(a) Each site or workplace safety and health program will need to include the following:

(i) Policy statements of the line of authority and accountability for implementing the program, the objectives of the program and the role of the site safety and health officer or manager and staff;

(ii) Means or methods for the development of procedures for identifying and controlling workplace hazards at the site;

(iii) Means or methods for the development and communication to employees of the various plans, work rules, standard operating procedures and practices that pertain to individual employees and supervisors;

(iv) Means for the training of supervisors and employees to develop the needed skills and knowledge to perform their work in a safe and healthful manner;

(v) Means to anticipate and prepare for emergency situations; and

(vi) Means for obtaining information feedback to aid in evaluating the program and for improving the effectiveness of the program. The management and employees should be trying continually to improve the effectiveness of the program thereby enhancing the protection being afforded those working on the site.

(b) Accidents on the site should be investigated to provide information on how such occurrences can be avoided in the future. When injuries or illnesses occur on the site or workplace, they will need to be investigated to determine what needs to be done to prevent this incident from occurring again. Such information will need to be used as feedback on the effectiveness of the program and the information turned into positive steps to prevent any reoccurrence. Receipt of employee suggestions or complaints relating to safety and health issues involved with site or workplace activities is also a feedback mechanism that can be used effectively to improve the program and may serve in part as an evaluative tool(s).

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(c) For the development and implementation of the program to be the most effective, professional safety and health personnel should be used. Certified safety professionals, board-certified industrial hygienists, or registered professional safety engineers are good examples of professional stature for safety and health managers who will administer the employer's program.

(2) The training programs for employees subject to the requirements of WAC 296-62-3040 through 296-62-30465 are expected to address: The safety and health hazards employees should expect to find on sites; what control measures or techniques are effective for those hazards; what monitoring procedures are effective in characterizing exposure levels; what makes an effective employer's safety and health program; what a site safety and health plan should include; hands-on training with personal protective equipment and clothing they may be expected to use; the contents of the WISHA standard relevant to the employee's duties and functions; and, employee's responsibilities under WISHA and other regulations. Supervisors will need training in their responsibilities under the safety and health program and its subject areas such as the spill containment program, the personal protective equipment program, the medical surveillance program, the emergency response plan and other areas.

(a) The training programs for employees subject to the requirements of WAC 296-62-3140 through 296-62-31465 should address: The employer's safety and health program elements impacting employees; the hazard communication program; the medical surveillance program; the hazards and the controls for such hazards that employees need to know for their job duties and functions. All require annual refresher training.

(b) The training programs for employees covered by the requirements of WAC 296-62-31110 will address those competencies required for the various levels of response such as: The hazards associated with hazardous substances; hazard identification and awareness; notification of appropriate persons; the need for and use of personal protective equipment including respirators; the decontamination procedures to be used; preplanning activities for hazardous substance incidents including the emergency response plan; company standard operating procedures for hazardous substance emergency responses; the use of the incident command system and other subjects. Hands-on training should be stressed whenever possible. Critiques done after an incident which include any evaluation of what worked, and what did not, and how can we do better the next time, may be counted as training time.

(3) Decontamination. Decontamination procedures will be tailored to the specific hazards of the site and will vary in complexity, and number of steps, depending on the level of hazard and the employee's exposure to the hazard. Decontamination procedures and PPE decontamination methods will vary depending upon the specific substance, since one procedure or method will not work for all substances. Evaluation of decontamination methods and procedures should be performed, as necessary, to assure that employees are not exposed to hazards by reusing PPE. References in WAC 296-62-3190, Appendix D, may be used for guidance in establishing an effective decontamination program. In addition, the United States Coast Guard Manual, "Policy Guidance for Response to Hazardous Chemical Releases," United States Department of Transportation, Washington, D.C. (COMDTINST M16465.30), is a good reference for establishing an effective decontamination program.

(4) Emergency response plans. States, along with designated districts within the states, will be developing or have developed emergency response plans. These state and district plans are to be used in the emergency response plans called for in this standard. Each employer needs to assure that its emergency response plan is compatible with the local plan. The major reference being used to aid in developing the state and local district plans is the Hazardous Materials Emergency Planning Guide, NRT-1. The current Emergency Response Guidebook from the United States Department of Transportation, CMA's CHEMTREC and the Fire Service Emergency Management Handbook may also be used as resources.

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Employers involved with treatment, storage, and disposal facilities for hazardous waste, which have the required contingency plan called for by their permit, would not need to duplicate the same planning elements. Those items of the emergency response plan that are properly addressed in the contingency plan may be substituted into the emergency response plan required in WAC 296-62-410, Part R, Emergency response to hazardous substance release or otherwise kept together for employer and employee use.

(5) Personal protective equipment programs. The purpose of personal protective clothing and equipment (PPE) is to shield or isolate individuals from the chemical, physical, and biologic hazards that may be encountered at a hazardous substance site.

(a) As discussed in Appendix B, no single combination of protective equipment and clothing is capable of protecting against all hazards. Thus PPE should be used in conjunction with other protective methods and its effectiveness evaluated periodically.

(b) The use of PPE can itself create significant worker hazards, such as heat stress, physical and psychological stress, and impaired vision, mobility, and communication. For any given situation, equipment and clothing will be selected that provide an adequate level of protection. However, over-protection, as well as under-protection, can be hazardous and should be avoided where possible.

(c) Two basic objectives of any PPE program will be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the PPE. To accomplish these goals, a comprehensive PPE program will include hazard identification, medical monitoring, environmental surveillance, selection, use, maintenance, and decontamination of PPE and its associated training.

(d) The written PPE program will include policy statements, procedures, and guidelines. Copies will be made available to all employees and a reference copy will be made available at the worksite. Technical data on equipment, maintenance manuals, relevant regulations, and other essential information will also be collected and maintained.

(6) Medical surveillance programs.

(a) Workers handling hazardous substances may be exposed to toxic chemicals, safety hazards, biologic hazards, and radiation. Therefore, a medical surveillance program is essential to assess and monitor workers' health and fitness for employment in hazardous waste operations and during the course of work; to provide emergency and other treatment as needed; and to keep accurate records for future reference.

(b) *The Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* developed by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the United States Coast Guard (USCG), and the Environmental Protection Agency (EPA); October 1985 provides an excellent example of the types of medical testing that should be done as part of a medical surveillance program.

(7) New technology and spill containment programs. Where hazardous substances may be released by spilling from a container that will expose employees to the hazards of the materials, the employer will need to implement a program to contain and control the spilled material. Diking and ditching, as well as use of absorbents like diatomaceous earth, are traditional techniques which have proven to be effective over the years. However, in recent years new products have come into the marketplace, the use of which complement and increase the effectiveness of these traditional methods. These new products also provide emergency responders and others with additional tools or agents to use to reduce the hazards of spilled materials.

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These agents can be rapidly applied over a large area and can be uniformly applied or otherwise can be used to build a small dam, thus improving the workers' ability to control spilled material. These application techniques enhance the intimate contact between the agent and the spilled material allowing for the quickest effect by the agent or quickest control of the spilled material. Agents are available to solidify liquid spilled materials, to suppress vapor generation from spilled materials, and to do both. Some special agents, which when applied as recommended by the manufacturer, will react in a controlled manner with the spilled material to neutralize acids or caustics, or greatly reduce the level of hazard of the spilled material.

There are several modern methods and devices for use by emergency response personnel or others involved with spill control efforts to safely apply spill control agents to control spilled material hazards. These include portable pressurized applicators similar to hand-held portable fire extinguishing devices, and nozzle and hose systems similar to portable fire fighting foam systems which allow the operator to apply the agent without having to come into contact with the spilled material. The operator is able to apply the agent to the spilled material from a remote position.

The solidification of liquids provides for rapid containment and isolation of hazardous substance spills. By directing the agent at run-off points or at the edges of the spill, the reactant solid will automatically create a barrier to slow or stop the spread of the material. Clean-up of hazardous substances as greatly improved when solidifying agents, acid or caustic neutralizers, or activated carbon absorbents are used. Properly applied, these agents can totally solidify liquid hazardous substances or neutralize or absorb them, which results in materials which are less hazardous and easier to handle, transport, and dispose of. The concept of spill treatment, to create less hazardous substances, will improve the safety and level of protection of employees working at spill clean-up operations or emergency response operations to spills of hazardous substances.

The use of vapor suppression agents for volatile hazardous substances, such as flammable liquids and those substances which present an inhalation hazard, is important for protecting workers. The rapid and uniform distribution of the agent over the surface of the spilled material can provide quick vapor knockdown. There are temporary and long-term foam-type agents which are effective on vapors and dusts, and activated carbon adsorption agents which are effective for vapor control and soaking-up of the liquid. The proper use of hose lines or hand-held portable pressurized applicators provides good mobility and permits the worker to deliver the agent from a safe distance without having to step into the untreated spilled material. Some of these systems can be recharged in the field to provide coverage of larger spill areas than the design limits of a single charged applicator unit. Some of the more effective agents can solidify the liquid flammable hazardous substances and at the same time elevate the flashpoint above 140 deg. F so the resulting substance may be handled as a nonhazardous waste material if it meets the United States Environmental Protection Agency's 40 CFR part 261 requirements (see particularly Sec. 261.21).

All workers performing hazardous substance spill control work are expected to wear the proper protective clothing and equipment for the materials present and to follow the employer's established standard operating procedures for spill control. All involved workers need to be trained in the established operating procedures; in the use and care of spill control equipment; and in the associated hazards and control of such hazards of spill containment work.

These new tools and agents are the things that employers will want to evaluate as part of their new technology program. The treatment of spills of hazardous substances or wastes at an emergency incident as part of the immediate spill containment and control efforts is sometimes acceptable to EPA and a permit exception is described in 40 CFR 264.1 (g)(8) and 265.1 (c)(11).

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3180, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 90-20-091 (Order 90-14), 296-62-3180, filed 10/1/90, effective 11/15/90; 89-21-018 (Order 89-10), 296-62-3180, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3180, filed 10/6/88, effective 11/7/88.]

WAC 296-62-3190 Appendix D--References. The following references may be consulted for further information on the subject of this notice:

(1) OSHA Instruction DFO CPL 2.70 - January 29, 1986, Special Emphasis Program: Hazardous Waste Sites.

(2) OSHA Instruction DFO CPL 2-2.37A - January 29, 1986, Technical Assistance and Guidelines for Superfund and Other Hazardous Waste Site Activities.

(3) OSHA Instruction DTS CPL 2.74 - January 29, 1986, Hazardous Waste Activity Form, OSHA 175.

(4) Hazardous Waste Inspections Reference Manual, U.S. Department of Labor, Occupational Safety and Health Administration, 1986.

(5) Memorandum of Understanding Among the National Institute for Occupational Safety and Health, the Occupational Safety and Health Administration, the United States Coast Guard, and the United States Environmental Protection Agency; Guidance for Worker Protection During Hazardous Waste Site Investigations and Clean-up and Hazardous Substance Emergencies; December 18, 1980.

(6) National Priorities List, 1st Edition, October 1984; U.S. Environmental Protection Agency, Revised periodically.

(7) Preparation of a Site Safety Plan, Field Standard Operating Procedures (F.S.O.P.) 9; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, April 1985.

(8) Standard Operating Safety Guidelines; U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division, Environmental Response Team; November 1984.

(9) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, National Institute for Occupational Safety and Health (NIOSH), Occupational Safety and Health Administration (OSHA), U.S. Coast Guard (USCG), and Environmental Protection Agency (EPA); October 1985.

(10) Protecting Health and Safety at Hazardous Waste Sites: An Overview, U.S. Environmental Protection Agency, EPA/625/9-85/006; September 1985.

(11) Hazardous Waste Sites and Hazardous Substance Emergencies, NIOSH Worker Bulletin, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; December 1982.

(12) Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide; U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health; October 1984.

(13) Report to the Congress on Hazardous Materials Training, Planning and Preparedness, Federal Emergency Management Agency, Washington, D.C., July 1986.

(14) Community Teamwork: Working Together to Promote Hazardous Materials Transportation Safety. U.S. Department of Transportation, Washington, D.C., May 1983.

[Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3190, filed 03/23/99, effective 06/23/99. [Statutory Authority: Chapter 49.17 RCW. 90-20-091 (Order 90-14), 296-62-3190, filed 10/1/90, effective 11/15/90; 89-21-018 (Order 89-10), 296-62-3190, filed 10/10/89, effective 11/24/89; 88-21-002 (Order 88-23), 296-62-3190, filed 10/6/88, effective 11/7/88.]

WAC 296-62-3195 Appendix E--Training curriculum guidelines. The following nonmandatory general criteria may be used for assistance in developing site-specific training curriculum used to meet the training

requirements of WAC 296-62-3040, through 296-62-30465, 296-62-31435 through 296-62-31445, 296-62-31465, 296-62-4102 through 296-62-41021, and 296-62-41023.

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These are generic guidelines and they are not presented as a complete training curriculum for any specific employer. Site-specific training programs must be developed on the basis of a needs assessment of the hazardous waste site, RCRA/TSDF, or emergency response operation in accordance with this chapter (chapter 296-62 WAC, Part P and Part R).

The guidance set forth here presents a highly effective program that in the areas covered would meet or exceed the regulatory requirements. In addition, other approaches could meet the regulatory requirements.

Suggested general criteria:

Definitions:

"Competent" means possessing the skills, knowledge, experience, and judgment to perform assigned tasks or activities satisfactorily as determined by the employer.

"Demonstration" means the showing by actual use of equipment or procedures.

"Hands-on training" means training in a simulated work environment that permits each student to have experience performing tasks, making decisions, or using equipment appropriate to the job assignment for which the training is being conducted.

"Initial training" means training required prior to beginning work.

"Lecture" means an interactive discourse with a class lead by an instructor.

"Proficient" means meeting a stated level of achievement.

"Site-specific" means individual training directed to the operations of a specific job site.

"Training hours" means the number of hours devoted to lecture, learning activities, small group work sessions, demonstration, evaluations, or hands-on experience.

Suggested core criteria:

(1) Training facility. The training facility should have available sufficient resources, equipment, and site locations to perform concise and hands-on training when appropriate. Training facilities should have sufficient organization, support staff, and services to conduct training in each of the courses offered.

(2) Training director. Each training program should be under the direction of a training director who is responsible for the program. The training director should have a minimum of two years of employee education experience.

(3) Instructors. Instructors should be deemed competent on the basis of previous documented experience in their area of instruction, successful completion of a "train-the-trainer" program specific to the topics they will teach, and an evaluation of instructional competence by the training director.

(a) Instructors should be required to maintain professional competency by participating in continuing education or professional development programs or by successfully completing an annual refresher course and having an annual review by the training director.

(b) The annual review by the training director should include observation of an instructor's delivery, a review of those observations with the trainer, and an analysis of any instructor or class evaluations completed by the students during the previous year.

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(4) Course materials. The training director should approve all course materials to be used by the training provider. Course materials should be reviewed and updated at least annually. Materials and equipment should be in good working order and maintained properly.

(a) All written and audio-visual materials in training curricula should be peer reviewed by technically competent outside reviewers or by a standing advisory committee.

(b) Reviewers should possess expertise in the following disciplines were applicable: Occupational health, industrial hygiene and safety, chemical/environmental engineering, employee education, or emergency response. One or more of the peer reviewers should be an employee experienced in the work activities to which the training is directed.

(5) Students. The program for accepting students should include:

(a) Assurance that the student is or will be involved in work where chemical exposures are likely and that the student possesses the skills necessary to perform the work.

(b) A policy on the necessary medical clearance.

(6) Ratios. Student-instructor ratios should not exceed thirty students per instructor. Hands-on activity requiring the use of personal protective equipment should have the following student-instructor ratios: For Level C or Level D personal protective equipment the ratio should be ten students per instructor. For Level A or Level B personal protective equipment the ratio should be five students per instructor.

(7) Proficiency assessment. Proficiency should be evaluated and documented by the use of a written assessment and a skill demonstration selected and developed by the training director and training staff. The assessment and demonstration should evaluate the knowledge and individual skills developed in the course of training. The level of minimum achievement necessary for proficiency must be specified in writing by the training director.

(a) If a written test is used, there should be a minimum of fifty questions. If a written test is used in combination with a skills demonstration, a minimum of twenty-five questions should be used. If a skills demonstration is used, the tasks chosen and the means to rate successful completion should be fully documented by the training director.

(b) The content of the written test or of the skill demonstration must be relevant to the objectives of the course.

The written test and skill demonstration should be updated as necessary to reflect changes in the curriculum and any update should be approved by the training director.

(c) The proficiency assessment methods, regardless of the approach or combination of approaches used, should be justified, documented and approved by the training director.

(d) The proficiency of those taking the additional courses for supervisors should be evaluated and documented by using proficiency assessment methods acceptable to the training director. These proficiency assessment methods must reflect the additional responsibilities borne by supervisory personnel in hazardous waste operations or emergency response.

(8) Course certificate. Written documentation should be provided to each student who satisfactorily completes the training course. The documentation should include:

(a) Student's name.

(b) Course title.

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(c) Course date.

(d) Statement that the student has successfully completed the course.

(e) Name and address of the training provider.

(f) An individual identification number for the certificate.

(g) List of the levels of personal protective equipment used by the student to complete the course.

(i) This documentation may include a certificate and an appropriate wallet-sized laminated card with a photograph of the student and the above information.

(ii) When such course certificate cards are used, the individual identification number for the training certificate should be shown on the card.

(9) Recordkeeping. Training providers should maintain records listing the dates courses were presented, the names of the individual course attendees, the names of those students successfully completing each course, and the number of training certificates issued to each successful student. These records should be maintained for a minimum of five years after the date an individual participated in a training program offered by the training provider. These records should be available and provided upon the student's request or as mandated by law.

(10) Program quality control. The training director should conduct or direct an annual written audit of the training program. Program modifications to address deficiencies, if any, should be documented, approved, and implemented by the training provider. The audit and the program modification documents should be maintained at the training facility.

Suggested Program Quality Control Criteria:

Factors listed here are suggested criteria for determining the quality and appropriateness of employee health and safety training for hazardous waste operations and emergency response.

(1) Training plan. Adequacy and appropriateness of the training program's curriculum development, instructor training, distribution of course materials, and direct student training should be considered, including:

(a) The duration of training, course content, and course schedules/agendas;

(b) The different training requirements of the various target populations, as specified in the appropriate generic training curriculum;

(c) The process for the development of curriculum, which includes appropriate technical input, outside review, evaluation, program pretesting.

(d) The adequate and appropriate inclusion of hands-on, demonstration, and instruction methods;

(e) Adequate monitoring of student safety, progress, and performance during the training.

(2) Program management, training director, staff, and consultants. Adequacy and appropriateness of staff performance and delivering an effective training program should be considered, including:

(a) Demonstration of the training director's leadership in assuring quality of health and safety training;

WAC 296-62-3195 (Cont.)

(b) Demonstration of the competency of the staff to meet the demands of delivering high quality hazardous waste employee health and safety training;

(c) Organization charts establishing clear lines of authority;

(d) Clearly defined staff duties including the relationship of the training staff to the overall program;

(e) Evidence that the training organizational structure suits the needs of the training program;

(f) Appropriateness and adequacy of the training methods used by the instructors;

(g) Sufficiency of the time committed by the training director and staff to the training program;

(h) Adequacy of the ratio of training staff to students;

(i) Availability and commitment of the training program of adequate human and equipment resources in the areas of:

(i) Health effects;

(ii) Safety;

(iii) Personal protective equipment (PPE);

(iv) Operational procedures;

(v) Employee protection practices/procedures;

(j) Appropriateness of management controls;

(k) Adequacy of the organization and appropriate resources assigned to assure appropriate training;

(l) In the case of multiple-site training programs, adequacy of management of the satellite centers.

(3) Training facilities and resources. Adequacy and appropriateness of the facilities and resources for supporting the training program should be considered, including:

(a) Space and equipment to conduct the training;

(b) Facilities for representative hands-on training;

(c) In the case of multiple-site programs, equipment and facilities at the satellite centers;

(d) Adequacy and appropriateness of the quality control and evaluations program to account for instructor performance;

(e) Adequacy and appropriateness of the quality control and evaluation program to ensure appropriate course evaluation, feedback, updating, and corrective action;

(f) Adequacy and appropriateness of disciplines and expertise being used within the quality control and evaluation program;

(g) Adequacy and appropriateness of the role of student evaluations to provide feedback for training program improvement.

WAC 296-62-3195 (Cont.)

(4) Quality control and evaluation. Adequacy and appropriateness of quality control and evaluation plans for training programs should be considered, including:

(a) A balanced advisory committee and/or competent outside reviewers to give overall policy guidance;

(b) Clear and adequate definition of the composition and active programmatic role of the advisory committee or outside reviewers;

(c) Adequacy of the minutes or reports of the advisory committee or outside reviewers' meetings or written communication;

(d) Adequacy and appropriateness of the quality control and evaluations program to account for instructor performance;

(e) Adequacy and appropriateness of the quality control and evaluation program to ensure appropriate course evaluation, feedback, updating, and corrective action;

(f) Adequacy and appropriateness of disciplines and expertise being used within the quality control and evaluation program;

(g) Adequacy and appropriateness of the role of student evaluations to provide feedback for training program improvement.

(5) Students. Adequacy and appropriateness of the program for accepting students should be considered, including:

(a) Assurance that the student already possess the necessary skills for their job, including necessary documentation;

(b) Appropriateness of methods the program uses to ensure that recruits are capable of satisfactorily completing training;

(c) Review and compliance with any medical clearance policy.

(6) Institutional environment and administrative support. The adequacy and appropriateness of the institutional environment and administrative support system for the training program should be considered, including:

(a) Adequacy of the institutional commitment to the employee training program;

(b) Adequacy and appropriateness of the administrative structure and administrative support.

(7) Summary of evaluation questions. Key questions for evaluating the quality and appropriateness of an overall training program should include the following:

(a) Are the program objectives clearly stated?

(b) Is the program accomplishing its objectives?

(c) Are appropriate facilities and staff available?

(d) Is there an appropriate mix of classroom, demonstration, and hands-on training?

WAC 296-62-3195 (Cont.)

(e) Is the program providing quality employee health and safety training that fully meets the intent of regulatory requirements?

(f) What are the program's main strengths?

(g) What are the program's main weaknesses?

(h) What is recommended to improve the program?

(i) Are instructors instructing according to their training outlines?

(j) Is the evaluation tool current and appropriate for the program content?

(k) Is the course material current and relevant to the target group?

Suggested Training Curriculum Guidelines:

The following training curriculum guidelines are for those operations specifically identified in this Part P, as requiring training. Issues such as qualifications of instructors, training certification, and similar criteria appropriate to all categories of operations addressed in this Part P, have been covered in the preceding section and are not readdressed in each of the generic guidelines. Basic core requirements for training programs that are addressed include: (1) General hazardous waste operations; (2) RCRA operations--Treatment, storage, and disposal facilities.

(1) General hazardous waste operations and site-specific training.

(a) Off-site training. Training course content for hazardous waste operations, required by WAC 296-62-3040 through 296-62-30465, should include the following topics or procedures:

(i) Regulatory knowledge.

(A) A review of this Part P and the core elements of an occupational safety and health program.

(B) The content of a medical surveillance program as outlined in WAC 296-62-3050 through 296-62-30535.

(C) The content of an effective site safety and health plan consistent with the requirements of WAC 296-62-30135(2).

(D) Emergency response plan and procedures as outlined in WAC 296-24-567 and 296-62-3110 through 296-62-31110.

(E) Adequate illumination.

(F) Sanitation recommendation and equipment.

(G) Review and explanation of WISHA's chemical hazard-communication standard WAC 296-800-170, and chapter 296-24 WAC, Part A-4, safety procedures for the control of hazardous energy (lockout/tagout).

(H) Review of other applicable standards including but not limited to those in the construction standards, chapter 296-155 WAC.

WAC 296-62-3195 (Cont.)

(I) Rights and responsibilities of employers and employees under applicable WISHA/OSHA and department of ecology (DOE)/Environmental Protection Association (EPA) regulations and laws.

(ii) Technical knowledge.

(A) Type of potential exposures to chemical, biological, and radiological hazards; types of human responses to these hazards and recognition of those responses; principles of toxicology and information about acute and chronic hazards; health and safety considerations of new technology.

(B) Fundamentals of chemical hazards including but not limited to vapor pressure, boiling points, flash points, pH, other physical and chemical properties.

(C) Fire and explosion hazards of chemicals.

(D) General safety hazards such as but not limited to electrical hazards, powered equipment hazards, motor vehicle hazards, walking-working surface hazards, excavation hazards, and hazards associated with working in hot and cold temperature extremes.

(E) Review and knowledge of confined space entry procedures in chapter 296-62 WAC, Part M.

(F) Work practices to minimize employee risk from site hazards.

(G) Safe use of engineering controls, equipment, and any new relevant safety technology or safety procedures.

(H) Review and demonstration of competency with air sampling and monitoring equipment that may be used in a site monitoring program.

(I) Container sampling procedures and safeguarding; general drum and container handling procedures including special requirement for laboratory waste packs, shock-sensitive wastes, and radioactive wastes.

(J) The elements of a spill control program.

(K) Proper use and limitations of material handling equipment.

(L) Procedures for safe and healthful preparation of containers for shipping and transport.

(M) Methods of communication including those used while wearing respiratory protection.

(iii) Technical skills.

(A) Selection, use maintenance, and limitations of personal protective equipment including the components and procedures for carrying out a respirator program to comply with chapter 296-62 WAC Part E, Respiratory Protection.

WAC 296-62-3195 (Cont.)

(B) Instruction in decontamination programs including personnel, equipment, and hardware; hands-on training including Levels A, B, and C ensembles and appropriate decontamination lines; field activities including the donning and doffing of protective equipment to a level commensurate with the employee's anticipated job function and responsibility and to the degree required by potential hazards.

(C) Sources for additional hazard information; exercises using relevant manuals and hazard coding systems.

(iv) Additional suggested items.

(A) A laminated, dated card or certificate with photo, denoting limitations and level of protection for which the employee is trained should be issued to those students successfully completing a course.

(B) Attendance should be required at all training modules, with successful completion of exercises and a final written or oral examination with at least fifty questions.

(C) A minimum of one-third of the program should be devoted to hands-on exercises.

(D) A curriculum should be established for the eight-hour refresher training required by WAC 296-62-30460, with delivery of such courses directed toward those areas of previous training that need improvement or reemphasis.

(E) A curriculum should be established for the required eight-hour training for supervisors. Demonstrated competency in the skills and knowledge provided in forty-hour and eighty-hour courses should be prerequisites for supervisor training.

(b) Refresher training. The eight-hour annual refresher training required in WAC 296-62-30460 should be conducted by qualified training providers. Refresher training should include at a minimum the following topics and procedures:

(i) Review of and retraining on relevant topics covered in the forty-hour and eighty-hour programs, as appropriate, using reports by the students on their work experiences.

(ii) Update on developments with respect to material covered in the forty-hour and eighty-hour courses.

(iii) Review of changes to pertinent provisions of DOE/EPA or WISHA/OSHA standards or laws.

(iv) Introduction of additional subject areas as appropriate.

(v) Hands-on review of new or altered PPE or decontamination equipment or procedures. Review of new developments in personal protective equipment.

(vi) Review of newly developed air and contaminant monitoring equipment.

(c) On-site training. The employer should provide employees engaged in hazardous waste site activities with information and training prior to initial assignment into their work area, as follows:

WAC 296-62-3195 (Cont.)

(i) The requirements of the hazard communication program including the location and availability of the written program, required lists of hazardous chemicals, and material safety data sheets.

(ii) Activities and locations in their work area where hazardous substance may be present.

(iii) Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearances, or other evidence (sight, sound or smell)) of hazardous chemicals being released, and applicable alarms from monitoring devices that record chemical releases.

(iv) The physical and health hazards of substances known or potentially present in the work area.

(v) The measures employees can take to help protect themselves from worksite hazards, including specific procedures the employer has implemented.

(vi) An explanation of the labeling system and material safety data sheets and how employees can obtain and use appropriate hazard information.

(vii) The elements of the confined space program including special PPE, permits, monitoring requirements, communication procedures, emergency response, and applicable lockout procedures.

(d) The employer should provide hazardous waste employees with information and training and should provide a review and access to the site safety and health plan as follows:

(i) Names of personnel and alternate responsible for site safety and health.

(ii) Safety and health hazards present on the site.

(iii) Selection, use, maintenance, and limitations of personal protective equipment specific to the site.

(iv) Work practices by which the employee can minimize risks from hazards.

(v) Safe use of engineering controls and equipment available on site.

(vi) Safe decontamination procedures established to minimize employee contact with hazardous substances, including:

(A) Employee decontamination;

(B) Clothing decontamination; and

(C) Equipment decontamination.

(vii) Elements of the site emergency response plan, including:

(A) Preemergency planning.

(B) Personnel roles and lines of authority and communication.

(C) Emergency recognition and prevention.

WAC 296-62-3195 (Cont.)

(D) Safe distances and places of refuge.

(E) Site security and control.

(F) Evacuation routes and procedures.

(G) Decontamination procedures not covered by the site safety and health plan.

(H) Emergency medical treatment and first aid.

(I) Emergency equipment and procedures for handling emergency incidents.

(e) The employer should provide hazardous waste employees with information and training on personal protective equipment used at the site, such as the following:

(i) PPE to be used based upon known or anticipated site hazards.

(ii) PPE limitations of materials and construction; limitations during temperature extremes, heat stress, and other appropriate medical considerations; use and limitations of respirator equipment as well as documentation procedures as outlined in chapter 296-62 WAC, Part E, Respiratory Protection.

(iii) PPE inspection procedures prior to, during, and after use.

(iv) PPE donning and doffing procedures.

(v) PPE decontamination and disposal procedures.

(vi) PPE maintenance and storage.

(vii) Task duration as related to PPE limitations.

(f) The employer should instruct the employee about the site medical surveillance program relative to the particular site, including:

(i) Specific medical surveillance programs that have been adapted for the site.

(ii) Specific signs and symptoms related to exposure to hazardous materials on the site.

(iii) The frequency and extent of periodic medical examinations that will be used on the site.

(iv) Maintenance and availability of records.

(v) Personnel to be contacted and procedures to be followed when signs and symptoms of exposures are recognized.

(g) The employees will review and discuss the site safety and health plan as part of the training program. The location of the site safety and health plan and all written programs should be discussed with employees including a discussion of the mechanisms for access, review, and references described.

(2) RCRA operations training for treatment, storage and disposal facilities.

(a) As a minimum, the training course required in WAC 296-62-31435 through 296-62-31440 and WAC 296-62-31465 should include the following topics:

WAC 296-62-3195 (Cont.)

(i) Review of the applicable parts of this Part P and the elements of the employer's occupational safety and health plan.

(ii) Review of relevant hazards such as, but not limited to, chemical, biological, and radiological exposures; fire and explosion hazards; thermal extremes; and physical hazards.

(iii) General safety hazards including those associated with electrical hazards, powered equipment hazards, lockout/tagout procedures, motor vehicle hazards and walking-working surface hazards.

(iv) Confined space hazards and procedures.

(v) Work practices to minimize employee risk from workplace hazards.

(vi) Emergency response plan and procedures including first aid meeting the requirements of WAC 296-62-31450.

(vii) A review of procedures to minimize exposure to hazardous waste and various type of waste streams, including the materials handling program and spill containment program.

(viii) A review of chemical hazard communication programs meeting the requirements of WAC 296-800-170.

(ix) A review of medical surveillance programs meeting the requirements of WAC 296-62-3050 and 296-62-31415 including the recognition of signs and symptoms of overexposure to hazardous substance including known synergistic interactions.

(x) A review of decontamination programs and procedures meeting the requirements of WAC 296-62-3100 and 296-62-31420.

(xi) A review of an employer's requirements to implement a training program and its elements.

(xii) A review of the criteria and programs for proper selection and use of personal protective equipment, including respirators.

(xiii) A review of the applicable appendices to this Part P (Appendices A through E).

(xiv) Principles of toxicology and biological monitoring as they pertain to occupational health.

(xv) Rights and responsibilities of employees and employers under applicable WISHA/OSHA and DOE/EPA regulations and laws.

(xvi) Hands-on exercises and demonstrations of competency with equipment to illustrate the basic equipment principles that may be used during the performance of work duties, including the donning and doffing of PPE.

(xvii) Sources of reference, efficient use of relevant manuals, and knowledge of hazard coding systems to include information contained in hazardous waste manifests.

(xviii) At least eight hours of hands-on training.

(xix) Training in the job skills required for an employee's job function and responsibility before they are permitted to participate in or supervise field activities.

WAC 296-62-3195 (Cont.)

(b) The individual employer should provide hazardous waste employees with information and training prior to an employee's initial assignment into a work area. The training and information should cover the following topics:

(i) The emergency response plan and procedures including first aid.

(ii) A review of the employer's hazardous waste handling procedures including the materials handling program and elements of the spill containment program, location of spill response kits or equipment, and the names of those trained to respond to releases.

(iii) The hazardous communication program meeting the requirements of WAC 296-800-170.

(iv) A review of the employer's medical surveillance program including the recognition of signs and symptoms of exposure to relevant hazardous substance including known synergistic interactions.

(v) A review of the employer's decontamination program and procedures.

(vi) A review of the employer's training program and the parties responsible for that program.

(vii) A review of the employer's personal protective equipment program including the proper selection and use of PPE based upon specific site hazards.

(viii) All relevant site-specific procedures addressing potential safety and health hazards. This may include, as appropriate, biological and radiological exposures, fire and explosion hazards, thermal hazards, and physical hazards such as electrical hazards, powered equipment hazards, lockout/tagout hazards, motor vehicle hazards, and walking-working surface hazards.

(ix) Safe use of engineering controls and equipment on-site.

(x) Names of personnel and alternates responsible for safety and health.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-3195, filed 05/09/01, effective 09/01/01. Statutory Authority: RCW 49.17.040. 99-07-097 (Order 98-38), § 296-62-3195, filed 03/23/99, effective 06/23/99. Statutory Authority: Chapter 49.17 RCW. 95-04-006, 296-62-3195, filed 1/18/95, effective 3/10/95.]

PART Q
HAZARDOUS CHEMICALS IN LABORATORIES

WAC

WAC 296-62-400 Occupational exposure to hazardous chemicals in laboratories. Reserved.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-400, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40001 Scope and application

(1) This section shall apply to all employers and employees engaged in the laboratory use of hazardous chemicals as follows:

(a) Where this section applies, it shall supersede, for laboratories, the requirements of all other WISHA health standards in chapter 296-62 WAC, except for any WISHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of subdivision (c) of this section apply.

(b) Prohibition of eye and skin contact where specified by any WISHA health standard shall be observed.

(c) Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for a WISHA regulated substance with exposure monitoring and medical surveillance requirements, of WAC 296-62-40007.

(2) This section shall not apply to:

(a) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in WAC 296-62-075, even if such use occurs in a laboratory.

(b) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(i) Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

WAC 296-62-40001 (Cont.)

(ii) Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40001, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40003 Definitions applicable to all sections of this chapter. Unless the context indicates otherwise, words used in this chapter shall have the meaning given in this section.

(1) **"Action level"** means a concentration designated in WAC 296-62-075 for a specific substance, calculated as an 8-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

(2) **"Carcinogen"** (see "select carcinogen").

(3) **"Chemical hygiene officer"** means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the chemical hygiene plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

(4) **"Chemical hygiene plan"** means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and meets the requirements of WAC 296-62-40009.

(5) **"Combustible liquid"** means any liquid having a flashpoint at or above 100°F (37.8°C), but below 200°F (93.3°C), except any mixture having components with flashpoints of 200°F (93.3°C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

(6) **"Compressed gas"** means:

(a) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C); or

(b) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F (21.1°C); or

(c) A liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72.

(7) **"Designated area"** means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

(8) **"Director"** means the director of the department of labor and industries or his/her designee.

(9) **"Emergency"** means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

(10) **"Employee"** means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

WAC 296-62-40003 (Cont.)

(11) **"Explosive"** means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

(12) **"Flammable"** means a chemical that falls into one of the following categories:

(a) **"Aerosol, flammable"** means an aerosol that, when tested by the method described in 16 C.F.R. 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(b) **"Gas, flammable"** means:

(i) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(ii) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(c) **"Liquid, flammable"** means any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(d) **"Solid, flammable"** means a solid, other than a blasting agent or explosive as defined in WAC 296-52-417, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 C.F.R. 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

(13) **"Flashpoint"** means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(a) Tagliabue Closed Tester (see American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 56-79))-for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg.F (37.8°C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(b) Pensky-Martens Closed Tester (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79))-for liquids with a viscosity equal to or greater than 45 SUS at 100 deg.F (37.8°C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(c) Setaflash Closed Tester (see American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Note: Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

(14) **"Hazardous chemical"** means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are

WAC 296-62-40003 (Cont.)

carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, senitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Note: Appendices A and B of the hazard communication standard (WAC 296-800-170) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

(15) **"Laboratory"** means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a nonproduction basis.

(16) "**Laboratory scale"** means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

(17) **"Laboratory-type hood"** means a device located in a laboratory, enclosure on five sides with a moveable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Note: Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

(18) **"Laboratory use of hazardous chemicals"** means handling or use of such chemicals in which all of the following conditions are met:

(a) Chemical manipulations are carried out on a "laboratory scale";

(b) Multiple chemical procedures or chemicals are used;

(c) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(d) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

(19) **"Medical consultation"** means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

(20) **"Organic peroxide"** means an organic compound that contains the bivalent -O-O-structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

(21) **"Oxidizer"** means a chemical other than a blasting agent or explosive as defined in WAC 296-52-417, that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

(22) **"Physical hazard"** means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

WAC 296-62-40003 (Cont.)

(23) **"Protective laboratory practices and equipment"** means those laboratory procedures, practices, and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

(24) **"Reproductive toxins"** means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

(25) **"Select carcinogen"** means any substance which meets one of the following criteria:

(a) It is regulated by WISHA as a carcinogen; or

(b) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

(c) It is listed under Group I ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(d) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(i) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m/3/; or

(ii) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(iii) After oral dosages of less than 50 mg/kg of body weight per day.

(26) **"Unstable (reactive)"** means a chemical which is the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.

(27) **"Water-reactive"** means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-40003, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40003, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40005 Permissible exposure limits. For laboratory uses of WISHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in WAC 296-62-075.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40005, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40007 Employee exposure determination.

(1) Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(2) Periodic monitoring. If the initial monitoring prescribed by subsection (1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of chapter 296-62 WAC.

(3) Termination of monitoring. Monitoring may be terminated in accordance with chapter 296-62 WAC.

WAC 296-62-40007 (Cont.)

(4) Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40007, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40009 Chemical hygiene plan--General.

(1) Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written chemical hygiene plan which is:

(a) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory; and

(b) Capable of keeping exposures below the limits specified in WAC 296-62-40005.

(2) The chemical hygiene plan shall be readily available to employees, employee representatives and, upon request, to the director of the department of labor and industries.

(3) The chemical hygiene plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

(a) Standard operating procedures for safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

(b) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment, and hygiene practices. Particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

(c) A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

(d) Provisions for employee information and training as prescribed in WAC 296-62-40011;

(e) The circumstances under which a particular laboratory operation, procedure, or activity shall require prior approval from the employer or the employer's designee before implementation;

(f) Provisions for medical consultation and medical examinations in accordance with WAC 296-62-40013;

(g) Designation of personnel responsible for implementation of the chemical hygiene plan including the assignment of a chemical hygiene officer and, if appropriate, establishment of a chemical hygiene committee; and

(h) Provisions for additional employee protection for work with particularly hazardous substances. These include “select carcinogens,” reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(i) Establishment of a designated area;

(ii) Use of containment devices such as fume hoods or glove boxes;

(iii) Procedures for safe removal of contaminated waste; and

WAC 296-62-40009 (Cont.)

(iv) Decontamination procedures.

(4) The employer shall review and evaluate the effectiveness of the chemical hygiene plan at least annually and update it as necessary.

(5) Appendix A of this section is nonmandatory but provides guidance to assist employers in the development of the chemical hygiene plan.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40009, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40011 Employee information and training.

(1) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(2) Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

(3) **Information.** Employees shall be informed of:

(a) The contents of this standard and its appendices which shall be made available to employees;

(b) The location and availability of the employer's chemical hygiene plan;

(c) The permissible exposure limits for WISHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable WISHA standard;

(d) Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(e) The location and availability of known reference material on the hazards, safe handling, storage, and disposal of hazardous chemicals found in the laboratory including, but not limited to, material safety data sheets received from the chemical supplier.

(4) **Training.** Employee training shall include:

(a) Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(b) The physical and health hazards of chemicals in the work area; and

(c) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(5) The employee shall be trained on the applicable details of the employer's written chemical hygiene plan.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40011, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40013 Medical consultation and medical examinations.

(1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

WAC 296-62-40013 (Cont.)

(a) Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(b) Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for a WISHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(c) Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(2) All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(3) **Information provided to the physician.** The employer shall provide the following information to the physician:

(a) The identity of the hazardous chemical(s) to which the employee may have been exposed;

(b) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(c) A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(4) **Physician's written opinion.**

(a) For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(i) Any recommendation for further medical follow-up;

(ii) The results of the medical examination and any associated tests;

(iii) Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and

(iv) A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(b) The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40013, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40015 Hazard Identification.

(1) With respect to labels and material safety data sheets:

WAC 296-62-40015 (Cont.)

(a) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(b) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(2) The following provisions shall apply to chemical substances developed in the laboratory:

(a) If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in the definition section, Part Q of this standard. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under WAC 296-62-40011.

(b) If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement WAC 296-62-40009.

(c) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the chemical hazard communication standard (WAC 296-800-170) including the requirements for preparation of material safety data sheets and labeling.

[Statutory Authority: RCW 49.17.010, .040, .050. 01-11-038, (Order 99-36), § 296-62-40015, filed 05/09/01, effective 09/01/01. Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-40015, filed 7/20/94, effective 9/20/94; 90-17-051 (Order 90-10), 296-62-40015, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40017 Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of WAC 296-62-071.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40017, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40019 Recordkeeping.

(1) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

(2) The employer shall assure that such records are kept, transferred, and made available in accordance with WAC 296-62-052.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40019, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40021 Start-up date. Employers shall have developed and implemented a written chemical hygiene plan no later than January 31, 1991.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40021, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40023 Appendices. The information contained in the appendices is not intended by itself to create any additional obligations not otherwise imposed or to detract from any existing obligation.

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40023, filed 8/13/90, effective 9/24/90.]

WAC 296-62-40025 Appendix A--National Research Council recommendations concerning chemical hygiene in laboratories (nonmandatory).

(1) **Table of contents.**

(a) General principles.

(i) Minimize all chemical exposures.

(ii) Avoid underestimation of risk.

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(iii) Provide adequate ventilation.

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(b) Responsibilities.

(i) Chief executive officer.

(ii) Supervisor of administrative unit.

(iii) Chemical hygiene officer.

(iv) Laboratory supervisor.

(v) Project director.

(vi) Laboratory worker.

(c) The laboratory facility.

(i) Design.

(ii) Maintenance.

(iii) Usage.

(iv) Ventilation.

(d) Components of the chemical hygiene plan.

(i) Basic rules and procedures.

(ii) Chemical procurement, distribution, and storage.

(iii) Environmental monitoring.

(iv) Housekeeping, maintenance, and inspections.

(v) Medical program.

(vi) Personal protective apparel and equipment.

(vii) Records.

(viii) Signs and labels.

(ix) Spills and accidents.

(x) Training and information.

(xi) Waste disposal.

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(e) General procedures for working with chemicals.

(i) General rules for all laboratory work with chemicals.

(ii) Allergens and embryotoxins.

(iii) Chemicals of moderate chronic or high acute toxicity.

(iv) Chemicals of high chronic toxicity.

(v) Animal work with chemicals of high chronic toxicity.

(f) Safety recommendations.

(g) Material safety data sheets.

(2) **Foreword.**

(a) As guidance for each employer's development of an appropriate laboratory chemical hygiene plan, the following nonmandatory recommendations are provided. They were extracted from "Prudent Practices for Handling Hazardous Chemicals in Laboratories" (referred to below as "Prudent Practices"), which was published in 1981 by the National Research Council and is available from the National Academy Press, 2101 Constitution Ave., N.W., Washington DC 20418.

(b) "Prudent practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify any requirements of the laboratory standard. This appendix merely presents pertinent recommendations from "prudent practices," organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a chemical hygiene plan. Users of this appendix should consult "prudent practices" for a more extended presentation and justification for each recommendation.

(c) "Prudent practices" deals with both safety and chemical hazards while the laboratory standard is concerned primarily with chemical hazards. Therefore, only those recommendations directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical hygiene" being substituted for the word "safety." However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

(d) The recommendations from "prudent practices" have been paraphrased, combined, or otherwise reorganized, and headings have been added. However, their sense has not been changed.

(e) Corresponding sections of the standard and this appendix.

(f) The following table is given for the convenience of those who are developing a chemical hygiene plan which will satisfy the requirements of WAC 296-62-40009. It indicates those sections of this appendix which are most pertinent to each of the sections of WAC 296-62-40009 and related sections.

WAC 296-62-40025 (Cont.)

Subsection and Topic in Laboratory Standard		Relevant Appendix Section
(3)(a)	Standard operating procedure for handling toxic chemicals.	(c)(d)(e)
(3)(b)	Criteria to be used for implementation of measures to reduce exposures.	(d)
(3)(c)	Fume hood performance.	(c)(iv)(B)
(3)(d)	Employee information and training (including emergency procedures).	(d)(x), (d)(ix)
(3)(e)	Requirements for prior approval of laboratory activities.	(e)(ii)((B), (e)(v)(B)
(3)(f)	Medical consultation and medical examinations.	(d)(v), (e)(v)(G)
(3)(g)	Chemical hygiene responsibilities.	(b)
(3)(h)	Special precautions for work with particularly hazardous substances.	(e)(ii)(iii)(v)

(3) In this appendix, those recommendations directed primarily at administrators and supervisors are given in sections (a) through (d). Those recommendations of primary concern to employees who are actually handling laboratory chemicals are given in section E. (Reference to page numbers in "prudent practices" are given in parentheses.)

(a) General principles for work with laboratory chemicals in addition to the more detailed recommendations listed below in sections (b) through (e), "prudent practices" expresses certain general principles, including the following:

(i) It is prudent to minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals (2, 10). Skin contact with chemicals should be avoided as a cardinal rule (198).

(ii) Avoid underestimation of risk. Even for substances of no known significant hazard, exposure should be minimized; for work with substances which present special hazards, special precautions should be taken (10, 37, 38). One should assume that any mixture will be more toxic than its most toxic component (30, 103) and that all substances of unknown toxicity are toxic (3, 34).

(iii) Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices (32, 198).

(iv) Institute a chemical hygiene program. A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity (6, 11). Its recommendations should be followed in academic teaching laboratories as well as by full-time laboratory workers (13).

(v) Observe the PELs, TLVs. The permissible exposure limits of WISHA and the threshold limit values of the American Conference of Governmental Industrial Hygienists should not be exceeded (13).

(b) Chemical hygiene responsibilities. Responsibility for chemical hygiene rests at all levels (6, 11, 21) including the:

(i) Chief executive officer, who has ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional chemical hygiene (7, 11).

(ii) Supervisor of the department or other administrative unit, who is responsible for chemical hygiene in that unit (7).

(iii) Chemical hygiene officer(s), whose appointment is essential (7) and who must:

(A) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices (7);

(B) Monitor procurement, use, and disposal of chemicals used in the lab (8);

(C) See that appropriate audits are maintained (8);

(D) Help project directors develop precautions and adequate facilities (10);

(E) Know the current legal requirements concerning regulated substances (50); and

(F) Seek ways to improve the chemical hygiene program (8, 11).

(iv) Laboratory supervisor, who has overall responsibility for chemical hygiene in the laboratory (21) including responsibility to:

(A) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided (21, 22);

(B) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment (21, 171);

(C) Know the current legal requirements concerning regulated substances (50, 231);

(D) Determine the required levels of protective apparel and equipment (156, 160, 162); and

(E) Ensure that facilities and training for use of any material being ordered are adequate (215).

(v) Project director or director of other specific operation, who has primary responsibility for chemical hygiene procedures for that operation (7).

(vi) Laboratory worker, who is responsible for:

(A) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures (7, 21, 22, 230); and

(B) Developing good personal chemical hygiene habits (22).

(c) The laboratory facility:

(i) Design. The laboratory facility should have:

(A) An appropriate general ventilation system (see C4 below) with air intakes and exhausts located so as to avoid intake of contaminated air (194);

(B) Adequate, well-ventilated stockrooms/storerooms (218, 219);

(C) Laboratory hoods and sinks (12, 162);

(D) Other safety equipment including eyewash fountains and drench showers (162, 169); and

WAC 296-62-40025 (Cont.)

(E) Arrangements for waste disposal (12, 240).

(ii) Maintenance. Chemical-hygiene-related equipment (hoods, incinerator, etc.) should undergo continuing appraisal and be modified if inadequate (11, 12).

(iii) Usage. The work conducted (10) and its scale (12) must be appropriate to the physical facilities available and, especially, to the quality of ventilation (13).

(iv) Ventilation.

(A) General laboratory ventilation. This system should: Provide a source of air for breathing and for input to local ventilation devices (199); it should not be relied on for protection from toxic substances released into the laboratory (198); ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day (194); direct air flow into the laboratory from nonlaboratory areas and out to the exterior of the building (194).

(B) Hoods. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals (199); each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use (200, 209). If this is not possible, work with substances of unknown toxicity should be avoided (13) or other types of local ventilation devices should be provided (199). (See pp. 201-206 for a discussion of hood design, construction, and evaluation.)

(C) Other local ventilation devices. Ventilated storage cabinets, canopy hoods, snorkels, etc., should be provided as needed (199). Each canopy hood and snorkel should have a separate exhaust duct (207).

(D) Special ventilation areas. Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system (208). Cold rooms and warm rooms should have provisions for rapid escape and for escape in the event of electrical failure (209).

(E) Modifications. Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate (12, 193, 204).

(F) Performance. Rate: 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control (194).

(G) Quality. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas (194, 195); airflow into and within the hood should not be excessively turbulent (200); hood face velocity should be adequate (typically 60-100 lfm) (200, 204).

(H) Evaluation. Quality and quantity of ventilation should be evaluated on installation (202), regularly monitored (at least every 3 months) (6, 12, 14, 195), and reevaluated whenever a change in local ventilation devices is made (12, 195, 207). See pp. 195-198 for methods of evaluation and for calculation of estimated airborne contaminant concentrations.

(d) Components of the chemical hygiene plan:

(i) Basic rules and procedures (recommendations for these are given in section (e), below).

WAC 296-62-40025 (Cont.)

(ii) Chemical procurement, distribution, and storage.

(A) Procurement. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved (215, 216). No container should be accepted without an adequate identifying label (216). Preferably, all substances should be received in a central location (216).

(B) Stockrooms/storerooms. Toxic substances should be segregated in a well-identified area with local exhaust ventilation (221). Chemicals which are highly toxic (227) or other chemicals whose containers have been opened should be in unbreakable secondary containers (219). Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity (218-19).

(C) Stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person (219).

(D) Distribution. When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible (223).

(E) Laboratory storage. Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom (225-6, 229).

(iii) Environmental monitoring. Regular instrumental monitoring of airborne concentrations is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices (12) or when a highly toxic substance is stored or used regularly (e.g., 3 times/week) (13).

(iv) Housekeeping, maintenance, and inspections.

(A) Cleaning. Floors should be cleaned regularly (24).

(B) Inspections. Formal housekeeping and chemical hygiene inspections should be held at least quarterly (6, 21) for units which have frequent personnel changes and semiannually for others; informal inspections should be continual (21).

(C) Maintenance. Eye wash fountains should be inspected at intervals of not less than 3 months (6). Respirators for routine use should be inspected periodically by the laboratory supervisor (169). Safety showers should be tested routinely (169). Other safety equipment should be inspected regularly. (E.g., every 3-6 months) (6, 24, 171). Procedures to prevent restarting of out-of-service equipment should be established (25).

(D) Passageways. Stairways and hallways should not be used as storage areas (24). Access to exits, emergency equipment, and utility controls should never be blocked (24).

(v) Medical program.

(A) Compliance with regulations. Regular medical surveillance should be established to the extent required by regulations (12).

WAC 296-62-40025 (Cont.)

(B) Routine surveillance. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable (11, 50).

(C) First aid. Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby (173). See pp. 176-178 for description of some emergency first-aid procedures.

(vi) Protective apparel and equipment. These should include for each laboratory:

(A) Protective apparel compatible with the required degree of protection for substances being handled (158-161);

(B) An easily accessible drench-type safety shower (162, 169);

(C) An eyewash fountain (162);

(D) A fire extinguisher (162-164);

Note: For additional requirements relating to portable fire extinguishers see WAC 296-800-300.

(E) Respiratory protection (164-9), fire alarm and telephone for emergency use (162) should be available nearby; and

(F) Other items designated by the laboratory supervisor (156, 160).

(vii) Records.

(A) Accident records should be written and retained (174).

(B) Chemical hygiene plan records should document that the facilities and precautions were compatible with current knowledge and regulations (7).

(C) Inventory and usage records for high-risk substances should be kept as specified in sections E3e below.

(D) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations (12).

(viii) Signs and labels. Prominent signs and labels of the following types should be posted:

(A) Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (28);

(B) Identity labels, showing contents of containers (including waste receptacles) and associated hazards (27, 48);

(C) Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits (27) and areas where food and beverage consumption and storage are permitted (24); and

(D) Warnings at areas or equipment where special or unusual hazards exist (27).

WAC 296-62-40025 (Cont.)

(ix) Spills and accidents.

(A) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure (200), evacuation, medical care, reporting, and drills (172).

(B) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms (172).

(C) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting (175).

(D) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit (8, 28).

(x) Information and training program.

(A) Aim: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs (5, 15).

(B) Emergency and personal protection training: Every laboratory worker should know the location and proper use of available protective apparel and equipment (154, 169).

(C) Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures (6).

(D) Such training as well as first-aid instruction should be available to (154) and encouraged for (176) everyone who might need it.

(E) Receiving and stockroom/storeroom personnel should know about hazards, handling equipment, protective apparel, and relevant regulations (217).

(F) Frequency of training: The training and education program should be a regular, continuing activity--not simply an annual presentation (15).

(G) Literature/consultation: Literature and consulting advice concerning chemical hygiene should be readily available to laboratory personnel, who should be encouraged to use these information resources (14).

(xi) Waste disposal program.

(A) Aim: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals (5).

(B) Content (14, 232, 233, 240): The waste disposal program should specify how waste is to be collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations (244).

(C) Discarding chemical stocks: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened (24, 27).

(D) Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage (226).

WAC 296-62-40025 (Cont.)

(E) Frequency of disposal: Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals (14).

(F) Method of disposal: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste (14, 238, 241).

(G) Indiscriminate disposal by pouring waste chemicals down the drain (14, 231, 242) or adding them to mixed refuse for landfill burial is unacceptable (14).

(H) Hoods should not be used as a means of disposal for volatile chemicals (40, 200).

(I) Disposal by recycling (233, 243) or chemical decontamination (40, 230) should be used when possible.

(e) Basic rules and procedures for working with chemicals. The chemical hygiene plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the subprograms mentioned above, these should include the general rules following:

(i) General rules. The following should be used for essentially all laboratory work with chemicals:

(A) Accidents and spills--Eye contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention (33, 172).

(B) Ingestion: Encourage the victim to drink large amounts of water (178).

(C) Skin contact: Promptly flush the affected area with water (33, 172, 178) and remove any contaminated clothing (172, 178). If symptoms persist after washing, seek medical attention (33).

(D) Clean-up. Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal (24, 33). See pp. 233-237 for specific clean-up recommendations.

(E) Avoidance of “routine” exposure: Develop and encourage safe habits (23); avoid unnecessary exposure to chemicals by any route (23);

(F) Do not smell or taste chemicals (32). Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices (199).

(G) Inspect gloves (157) and test glove boxes (208) before use.

(H) Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres (209).

(I) Choice of chemicals: Use only those chemicals for which the quality of the available ventilation system is appropriate (13).

(J) Eating, smoking, etc.: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present (22, 24, 32, 40); wash hands before conducting these activities (23, 24).

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(K) Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware, or utensils which are also used for laboratory operations (23, 24, 226).

(L) Equipment and glassware: Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware (25). Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur (25). Use equipment only for its designed purpose (23, 26).

(M) Exiting: Wash areas of exposed skin well before leaving the laboratory (23).

(N) Horseplay: Avoid practical jokes or other behavior which might confuse, startle, or distract another worker (23).

(O) Mouth suction: Do not use mouth suction for pipeting or starting a siphon (23, 32).

(P) Personal apparel: Confine long hair and loose clothing (23, 158). Wear shoes at all times in the laboratory but do not wear sandals, perforated shoes, or sneakers (158).

(Q) Personal housekeeping: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day (24).

(R) Personal protection: Assure that appropriate eye protection (154-156) is worn by all persons, including visitors, where chemicals are stored or handled (22, 23, 33, 154).

(S) Wear appropriate gloves when the potential for contact with toxic materials exists (157); inspect the gloves before each use, wash them before removal, and replace them periodically (157). (A table of resistance to chemicals of common glove materials is given p. 159.)

(T) Use appropriate (164-168) respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls (164-5), inspecting the respirator before use (169).

(U) Use any other protective and emergency apparel and equipment as appropriate (22, 157-162).

(V) Void use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken (155).

(W) Remove laboratory coats immediately on significant contamination (161).

(X) Planning: Seek information and advice about hazards (7), plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation (22, 23).

(Y) Unattended operations: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation (27, 128).

(Z) Use of hood: Use the hood for operations which might result in release of toxic chemical vapors or dust (198-9).

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(AA) As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm (13).

(BB) Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made (200); keep materials stored in hoods to a minimum and do not allow them to block vents or air flow (200).

(CC) Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off" (200).

(DD) Vigilance: Be alert to unsafe conditions and see that they are corrected when detected (22).

(EE) Waste disposal: Assure that the plan for each laboratory operation includes plans and training for waste disposal (230).

(FF) Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the chemical hygiene plan (22, 24).

(GG) Do not discharge to the sewer concentrated acids or bases (231); highly toxic, malodorous, or lachrymatory substances (231); or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage, or obstruct flow (242).

(HH) Working alone: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous (28).

(ii) Working with allergens and embryotoxins.

(A) Allergens (examples: Diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity (35).

(B) Embryotoxins (34-5) (examples: Organomercurials, lead compounds, formamide): Women of childbearing age shall handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.

(C) Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

(D) Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

(E) Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

(iii) Work with chemicals of moderate chronic or high acute toxicity.

Examples: diisopropylflurophosphate (41), hydrofluoric acid (43), hydrogen cyanide (45).

(iv) Supplemental rules to be followed in addition to those mentioned above (Procedure B of "prudent practices," pp. 39-41):

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(A) Aim: To minimize exposure to these toxic substances by any route using all reasonable precautions (39).

(B) Applicability: These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities (39).

(C) Location: Use and store these substances only in areas of restricted access with special warning signs (40, 229).

(D) Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) (40) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance (39); trap released vapors to prevent their discharge with the hood exhaust (40).

(E) Personal protection: Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate) (39). Always wash hands and arms immediately after working with these materials (40).

(F) Records: Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved (40, 229).

(G) Prevention of spills and accidents: Be prepared for accidents and spills (41).

(H) Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity (39).

(I) Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper (40).

(J) If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment (41).

(K) Waste: Thoroughly decontaminate or incinerate contaminated clothing or shoes (41). If possible, chemically decontaminate by chemical conversion (40).

(L) Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite) (40).

(v) Work with chemicals of high chronic toxicity.

Examples: Dimethylmercury and nickel carbonyl (48), benzo-a-pyrene (51), N-nitrosodiethylamine (54), other human carcinogens or substances with high carcinogenic potency in animals (38).

(vi) Further supplemental rules to be followed, in addition to all these mentioned above, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) (47). (Procedure A of "Prudent Practices" pp. 47-50).

(A) Access: Conduct all transfers and work with these substances in a "controlled area": A restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substances being used and necessary precautions (48).

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(B) Approvals: Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor (48).

(C) Noncontamination/decontamination: Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood (49). Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area (49, 50).

(D) Decontaminate the controlled area before normal work is resumed there (50).

(E) Exiting: On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck (49).

(F) Housekeeping: Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder (50).

(G) Medical surveillance: If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance (50).

(H) Records: Keep accurate records of the amounts of these substances stored (229) and used, the dates of use, and names of users (48).

(I) Signs and labels: Assure that the controlled area is conspicuously marked with warning and restricted access signs (49) and that all containers of these substances are appropriately labeled with identity and warning labels (48).

(J) Spills: Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available (233-4).

(K) Storage: Store containers of these chemicals only in a ventilated, limited access (48, 227, 229) area in appropriately labeled, unbreakable, chemically resistant, secondary containers (48, 229).

(L) Glove boxes: For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (48). For a positive pressure glove box, thoroughly check for leaks before each use (49). In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood (49).

(M) Waste: Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel (49, 50, 233).

(vii) Animal work with chemicals of high chronic toxicity.

(A) Access: For large scale studies, special facilities with restricted access are preferable (56).

(B) Administration of the toxic substance: When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters (56).

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(C) Aerosol suppression: Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood) (55, 56).

(D) Personal protection: When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator) (56).

(E) Waste disposal: Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to nontoxic products (238); otherwise, package the waste appropriately for burial in an EPA-approved site (239).

(f) Safety recommendations. The above recommendations from "prudent practices" do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures. Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene:

(i) Corrosive agents: (35-6)

(ii) Electrically powered laboratory apparatus: (179-92)

(iii) Fires, explosions: (26, 57-74, 162-4, 174-5, 219-20, 226-7)

(iv) Low temperature procedures: (26, 88)

(v) Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101)

(g) Material safety data sheets. Material safety data sheets are presented in "prudent practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided.)

*Acetyl peroxide (105) *Acrolein (106) *Acrylontrile (107) Ammonia (anhydrous) (91) *Aniline (109) *Benzene (110) *Benzo[a]pyrene (112) *Bis(chloromethyl) ether (113) Boron trichloride (91) Boron trifluoride (92) Bromine (114) *Tert-butyl hydroperoxide (148) *Carbon disulfide (116) Carbon monoxide (92) *Carbon tetrachloride (118) *Chlorine (119) Chlorine trifluoride (94) *Chloroform (121) Chloromethane (93) *Diethyl ether (122) Diisopropyl fluorophosphate (41) *Dimethylformamide (123) *Dimethyl sulfate (125) *Dioxane (126) *Ethylene dibromide (128) *fluorine (95) *Formaldehyde (130) *Hydrazine and salts (132) Hydrofluoric acid (43) Hydrogen bromide (98) Hydrogen chloride (98) *Hydrogen cyanide (133) *Hydrogen sulfide (135) Mercury and compounds (52) *Methanol (137) *Morpholine (138) *Nickel carbonyl (99) *Nitrobenzene (139) Nitrogen dioxide (100) N-nitrosodiethylamine (54) *Peracetic acid (141) *Phenol (142) *Phosgene (143) *Pyridine (144) *Sodium azide (145) *Sodium cyanide (147) Sulfur dioxide (101) *Trichloroethylene (149) *Vinyl chloride (150)

[Statutory Authority: Chapter 49.17 RCW. 94-15-096 (Order 94-07), 296-62-40025, filed 7/20/94, effective 9/20/94; 90-17-051 (Order 90-10), 296-62-40025, filed 8/13/90, effective 9/24/90.]

296-62-40027 Appendix B--References (nonmandatory).

(1) The following references are provided to assist the employer in the development of a chemical hygiene plan. The materials listed below are offered as nonmandatory guidance. References listed here do not imply specific endorsement of a book, opinion, technique, policy, or a specific solution for a safety or health problem. Other references not listed here may better meet the needs of a specific laboratory. Reference materials for the development of the chemical hygiene plan are:

(a) American Chemical Society, Safety in Academic Chemistry Laboratories, 4th edition, 1985.

(b) Fawcett, H.H. and W. S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd edition, Wiley-Interscience, New York, 1982.

(c) Flury, Patricia A., Environmental Health and Safety in the Hospital Laboratory, Charles C. Thomas Publisher, Springfield IL, 1978.

(d) Green, Michael E. and Turk, Amos, Safety in Working with Chemicals, Macmillan Publishing Co., NY, 1978.

(e) Kaufman, James A., Laboratory Safety Guidelines, Dow Chemical Co., Box 1713, Midland, MI 48640, 1977.

(f) National Institutes of Health, NIH Guidelines for the Laboratory use of Chemical Carcinogens, NIH Pub. No. 81-2385, GPO, Washington, DC 20402, 1981.

(g) National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, DC, 1983.

(h) National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington, DC, 1981.

(i) Renfrew, Malcolm, Ed., Safety in the Chemical Laboratory, Vol. IV, J. Chem. Ed., American Chemical Society, Easlon, PA, 1981.

(j) Steere, Norman V., Ed., Safety in the Chemical Laboratory, J. Chem. Ed. American Chemical Society, Easlon, PA, 18042, Vol. I, 1967, Vol. II, 1971, Vol. III 1974.

(k) Steere, Norman V., Handbook of Laboratory Safety, the Chemical Rubber Company Cleveland, OH, 1971.

(l) Young, Jay A., Ed., Improving Safety in the Chemical Laboratory, John Wiley & Sons, Inc. New York, 1987.

(2) Hazardous substances information:

(a) American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes, P.O. Box 1937 Cincinnati, OH 45201 (latest edition).

(b) Annual Report on Carcinogens, National Toxicology Program U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington, DC, (latest edition).

(c) Best Company, Best Safety Directory, Vols. I and II, Oldwick, N.J., 1981.

(d) Bretherick, L., Handbook of Reactive Chemical Hazards, 2nd edition, Butterworths, London, 1979.

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(e) Bretherick, L., Hazards in the Chemical Laboratory, 3rd edition, Royal Society of Chemistry, London, 1986.

(f) Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Govt. Printing Office, Washington, DC 20402 (latest edition).

(g) IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest editions).

(h) NIOSH/OSHA Pocket Guide to Chemical Hazards. NIOSH Pub. No. 85-114, U.S. Government Printing Office, Washington, DC, 1985 (or latest edition).

(i) Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123 U.S. Government Printing Office, Washington, DC, 1981.

(j) Patty, F.A., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, NY (Five Volumes).

(k) Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402.

(l) The Merck Index: An Encyclopedia of Chemicals and Drugs. Merck and Company Inc. Rahway, N.J., 1976 (or latest edition).

(m) Sax, N.I. Dangerous Properties of Industrial Materials, 5th edition, Van Nostrand Reinhold, NY., 1979.

(n) Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, NJ, 1981.

(3) **Information on ventilation:**

(a) American Conference of Governmental Industrial Hygienists Industrial Ventilation, 16th edition Lansing, MI, 1980.

(b) American National Standards Institute, Inc. American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems ANSI Z 9.2-1979 American National Standards Institute, N.Y. 1979.

(c) Imad, A.P. and Watson, C.L. Ventilation Index: An Easy Way to Decide about Hazardous Liquids, Professional Safety pp 15-18, April 1980.

(d) National Fire Protection Association, Fire Protection for Laboratories Using Chemicals NFPA-45, 1982.

(e) Safety Standard for Laboratories in Health Related Institutions, NFPA, 56c, 1980.

(f) Fire Protection Guide on Hazardous Materials, 7th edition, 1978.

(g) National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

(h) Scientific Apparatus Makers Association (SAMA), Standard for Laboratory Fume Hoods, SAMA LF7-1980, 1101 16th Street, NW., Washington, DC 20036.

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(4) **Information on availability of referenced material:**

(a) American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.

(b) American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.

(Approved by the Office of Management and Budget under control number 1218-0131.)

[Statutory Authority: Chapter 49.17 RCW. 90-17-051 (Order 90-10), 296-62-40027, filed 8/13/90, effective 9/24/90.]